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Science and Invention

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ELECTRICAL EXPERIMENTER

GUIDED AIRPLANE MAKES 150 MILES PER HOUR

See Page 610

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Whole No. 103

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

November, 1921
No. 7

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Life on Mars

THE recent announcement of Senatore Marconi stating that he feels convinced that certain radio signals, which he has received on an enormously long wave length, come from the planet Mars, has stirred anew the imagination of laymen as well as of scientists.

The scientific world is preparing feverishly for the great opposition which takes place between the two planets in 1924. At this time Mars will come closer to the earth than it will be for several generations. The distance in 1924 will be about 35,000,000 miles—a mere trifle, astronomically speaking.

We have always upheld the contention that there is life on Mars. All conclusions, scientific as well as otherwise, point to this. The telescope reveals to us that Mars has an atmosphere the same as our own, with the difference that the Martian atmosphere is probably very much more attenuated. We know that there is water on Mars, because we can see its polar snow caps. These snow caps melt on Mars every season. We can also see how the advancing Martian waters produce certain coloration upon the land surface, which Percival Lowell interpreted as vegetation upon that planet. Given air and water as well as a fair amount of sunlight, all of which Mars possesses, the chances are overwhelmingly in favor of the contention that Mars bears life.

What form of life is represented on the ruddy planet would be foolish for anyone to assume. That Mars is a vastly older planet than the earth is well known. It probably cooled off millions of years before the earth reached a similar condition, but as yet Mars has not reached the state of the moon, which is almost a dead world today.

From life on Mars to an intelligence, which could send us messages as we know them, is a far cry, although of course it is probable. On the other hand, we find on our earth that the various animal species take the most bewildering forms in their evolution. Many types reach a certain state of development, and then perish, the species or type dying out. If there is intelligence, as we know it, on Mars, it is impossible to tell what form or shape these intelligent creatures would take.

We use the word intelligence advisedly, because it is a complex term. What, after all, is intelligence? Thus an observer from Mars might well doubt that the human race is endowed with intelligence at all. A careful observer might see for instance that the ant or bee had reached a higher degree of intelligence than has the human race as such. The fact that we humans have turned all the resources of this planet to our own use, does not mean that we are endowed with a superior intelligence. Who knows that the ant or bee does not think—if think they can (and probably do)—that they have an intelligence and civilization as high, and infinitely higher than ours?

This argument may sound foolish, but is it? The case in point is that the ant as well as the bee certainly know much better how to do things as far as organization, community laws, welfare of the nation, etc., is concerned, than we humans do.

We call all their acts instinct, which is a good cloak to cover our own ignorance. At the same time, we know that ants and bees and many other insects have many qualities, of which we are totally unaware. Thus bees will return to their home if transported over a distance of many miles. So will carrier pigeons. If we therefore should make the suggestion that ants might be in communication with Mars or some other planet by means of some unknown waves, we probably would be condemned severely. But we know that in Nature anything is possible, and we think we had better leave alone the word impossible, until we know more about life and all its mysterious phases.

H. GERNSBACK.

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Volume IX
Whole No. 103

Science and Invention

H. GERNSBACK, - EDITOR
H. WINFIELD SECOR, - ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., - ASSOCIATE EDITOR

NOVEMBER
1921
No. 7

A New Nose Without Cutting the Skin

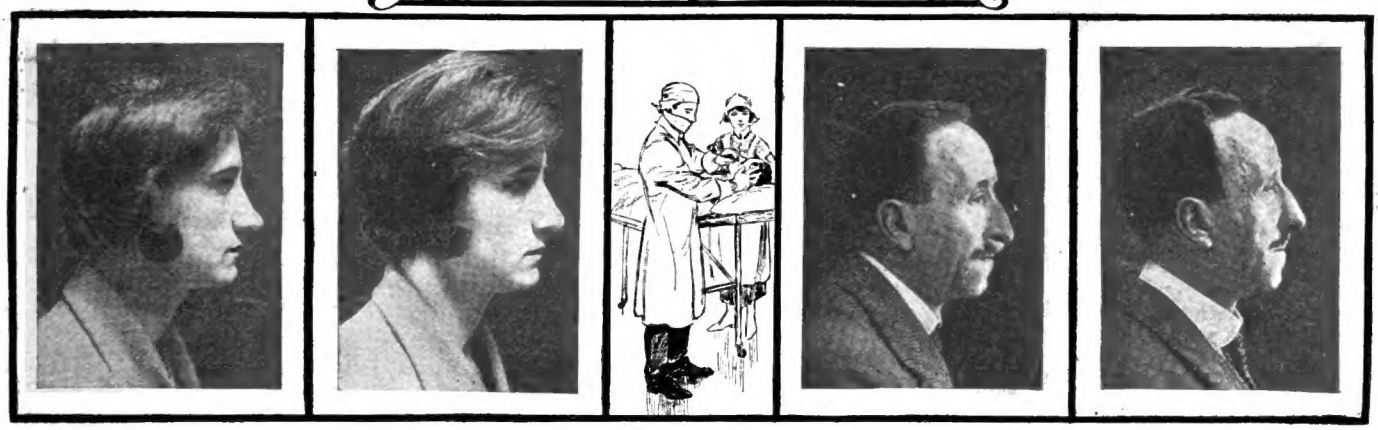
By A. N. MIRZAOFF

ARE you satisfied with your nose? Would you be better looking if you had a different kind of a nose? These are questions which many a person has asked, when he or she looked into the mirror. Some noses are so deformed that no matter how lovely may be the other features of the face, the physiological effect is detrimental to the success of the individual. Have you ever seen a young woman, who at first sight, when indistinctly seen, appeared to be a vision of alluring beauty, but who, on closer inspection, was utterly a disillusion, because her nose was grossly convex, concave or crooked? She, no doubt noticed the change in your expression of regard, no matter how cleverly you may have tried to conceal your feelings.

Two Top Photos Show "Deviated Nose" Before and After Being Straightened.

Two Photos Below at Left Show "Duck Nose" Before and After Correcting.

The Two Photos at Lower Right Demonstrate a Pronounced "Before and After" Nose Correction. The Outer Skin Is Not Cut, All of the Minor Surgery Being Carried on from Within the Nose.



Realizing this misfortune thrown upon some persons thru accident or birth, a celebrated French surgeon has devoted his genius to eradicating the defective noses of such persons. Without a scratch of the skin he has succeeded in changing the whole contour of a nose, transforming it as by magic from an ugly to a perfect feature. His method is now extensively used in continental cities and people travel or voyage great distances to take advantage of his skill in correcting noses. He works with the deft hand of a sculptor, and indeed he must possess the eye of one, to be able to shape the most prominent feature of a person's face with the delicacy of line required for just precisely the correct amount of improvement. To overdo the work would spoil one's looks in an opposite direction, as would a sculptor who removed too much of the nose of his statue.

Dr. Julien Bourguet, late Director and Chief of the Clinic of the Licencié et Sciences, of Paris, France, is the distinguished surgeon-sculptor who has come to the rescue of humanity. First he critically studies the contour of his patient's face. His practised eye at once tells what is wrong. If the patient's nose is convex, one of the most common defects, he discovers the cause, and finds it with the aid of a "Clar reflector" a sort of miniature periscope by which he is able to see the hidden structure of the nasal cavity, and to judge how much of the superfluous cartilage must be removed.

Local anaesthesia generally produced by a solution of cocaine-adrenalin makes the operation quite painless for the patient. The skin is separated from the underlying framework and the cutaneous sheath is then raised in such a way as to permit a close examination with the aid of the little optical instrument above mentioned. Dr. Bourguet makes use of a small hand saw or an electric burr having either a button on it, or a rounded end. The delicate work is finished with a file which obliterates any inequalities of the nasal foundation. The skin is then allowed to adjust itself on its newly formed support, and after about ten days of a swollen nose the patient can look at himself, or herself in the mirror. From the numerous testimonials from those who have undergone this operation, the results have been pleasing surprises. Generally in a fortnight the patient can go out and enjoy life, without the handicap of a deformed feature.

The eminent surgeon carries in his mind's eye the image of an ideal nose, and with that always before him his work is done to a perfect standard. Sometimes one will need only a correction of a nasal enlargement in which no "hump" is present. In such cases it is often necessary to bring closer together the two bones which produce the defect. Dr. Bourguet says, "If I have to correct a nasal enlargement without a hump, I bring nearer together the two ascending rami of the superior maxillary bones, or I oblate them by the endonasal channel when they make too great a protuberance under the skin. According to circumstances, the triangular cartilages and those of the nostrils are also operated upon. In order to bring the tip of the nose nearer to the upper lip, a rectangular portion of the interior branch of the alar cartilage is removed and the remaining parts sewn together. To raise the tip, a triangular piece of the septum is removed with the scissors and the uniting of the wound by stitching raises the point of the nose."

But it must be born in mind that thruout these operations the skin must not show the trace of a scar. The work is done entirely from the inside. Sometimes it is necessary to combine various methods in the treatment of a single defect, and not the least of the surgeon's skill lies in deciding what is best suited to meet particular instances. (*Continued on page* 661)

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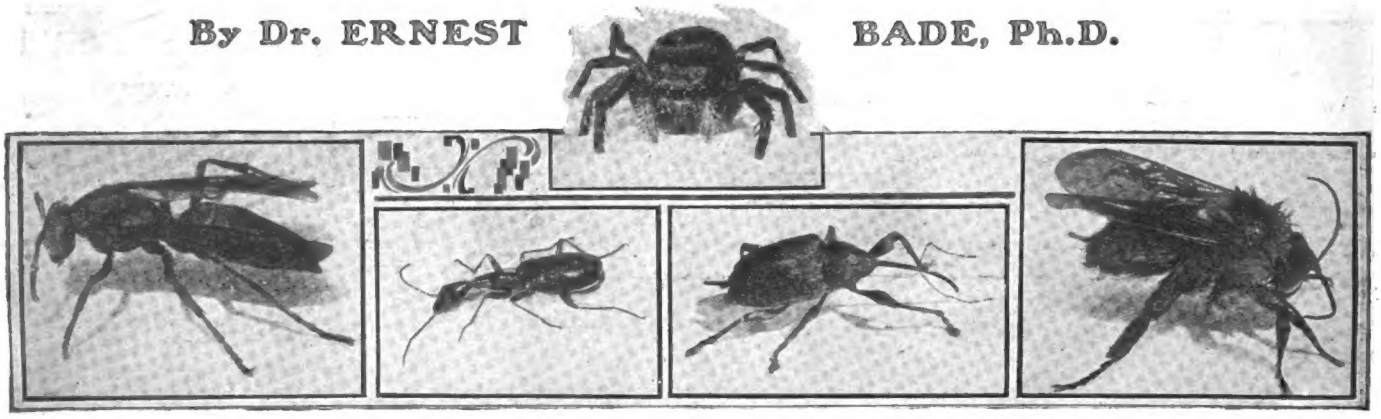
A Macrophotographic Camera

By Dr. ERNEST BADE, Ph.D.



Polistes, a Wasp. (Top Center) Dendryphantes Whitmanni (Spider) Casnonia Pennsylvanica Nut Weevil (Balaninus). Bumble-bee.

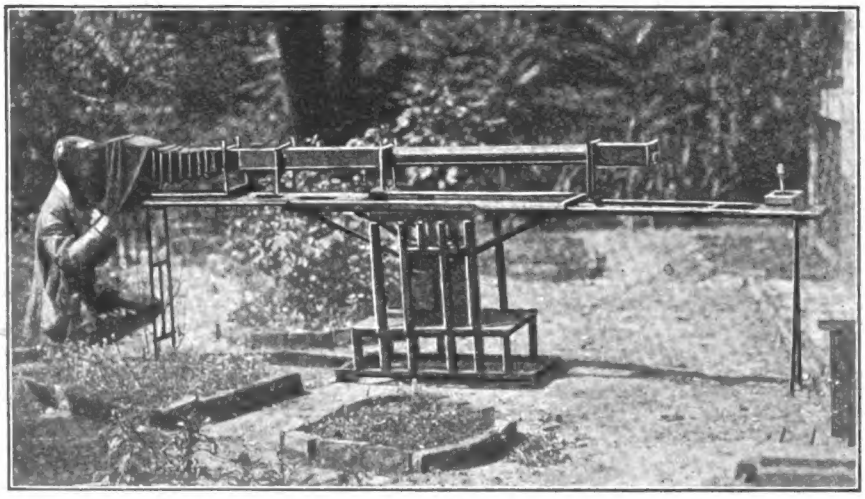
A CAMERA taking enlarged pictures of things is called a macrophotographic camera. Such an instrument, while enlarging the object, is by no means a microscope, altho it can be substituted for one. It functions somewhat like the latter but will only enlarge the object a few times. This is of inestimable service under certain circumstances, especially where an ordinary camera will give pictures which are too small, and which will not show sufficient details, and where the microscope will enlarge too much.

The necessary prerequisite in order to take good pictures, is a double anastigmat lens of fairly wide aperture. A cheap lens will give foggy and distorted plates, and it is absolutely useless to attempt to take macrophotographs with anything except a high-class lens having a wide aperture.

If such a photographic lens is at hand, then the tubes necessary for the different magnifications can be made. These consist of various lengths of thin boards nailed together in the shape of a square box. If a large paper tube is at hand, this can also be used. All joints must be made absolutely light tight, and this is best accomplished by pasting dull black paper over the entire outer shell of the tubes. The inside should also be pasted with such paper, or painting the interior with dull black paint will serve the purpose just as well.

The smaller sections should be about one foot long, and their internal diameter should at least be one-third larger than the diameter of the lens. Two or three such sections should be sufficient. Then one section should be made which is two feet long, and another one which is three feet long. If a camera with a double bellows extension is used, these sections will be all that is required; otherwise it may be well to make two more sections, one three-quarters of a foot long, and the other half a foot long.

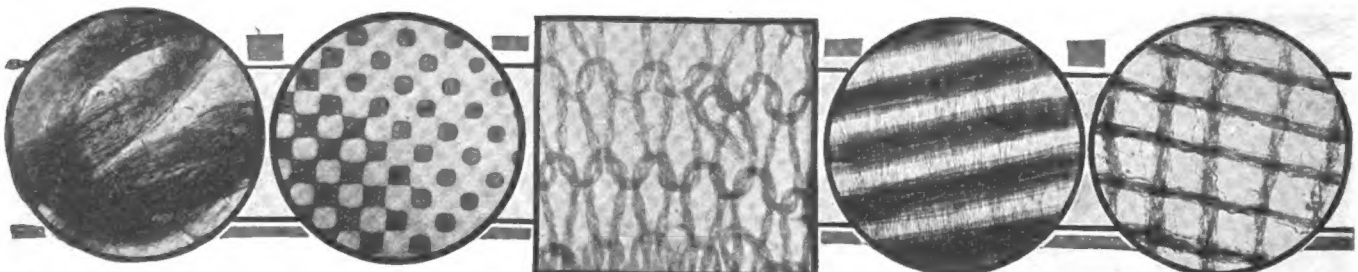
It is absolutely essential, that all these sections be made interchangeable, so that any number or all of them can be used at one time. If only one or two of the sections are used, then the magnification will be but small, and if all of them are used, the magnification will be comparatively large. With the lower magnifications, exposures of about ten seconds will be sufficient; with higher ones, one-half to three-quarters of a minute will probably be necessary. The length of exposure will, of course, depend upon the lens, as well as upon the magnification. Enlargements of more than 12 diameters are not satisfactory, since but little light passes thru the lens and reaches the plate. Under these circumstances exposures must always be made with direct sunlight, all other illuminations are too weak, and if used, would require exposures ranging from one-half to one hour, and the resulting pictures would practically be without detail.



This Photograph Shows a "Macrophotographic" Camera Arranged with a Bellows 10 Feet Long. In Lieu of Such Long Bellows, Paper or Cardboard Tubes, Sealed Light-Tight, can be Employed Successfully. A Macrophotographic Camera Is One That Makes Enlarged Pictures of Objects.

The preliminary focusing is done on the ground glass. Here the image of the object must be perfectly visible before accurate focusing can be accomplished. When this has been done, the ground glass is removed, and, with a hand lens held in such a position that its focus (*i. e.*, the focus of the hand lens) lies in the plane of the removed ground glass, the camera is adjusted by the bellows until the detail of the object *nearest the lens* is sharp and distinct.

(*Continued on page* 664)



One Loop of a Gas Mantle 40 Times Enlarged, Showing the Structure of the Cotton Base.

A Section of a Half-tone Cut Printed on the Best Grade of Paper, and Made with the Finest Screen, 40 Times Enlarged.

A Part of Our Common Gas Mantle, 12 Times Enlarged. Looks Quite Surprising, Doesn't It?

A Piece of Silk 40 Times Enlarged, Taken from a Colored Tie, Showing the Delicate Texture of the Fibres.

A Piece of Organdy Dress Goods, 40 Times Enlarged, Showing Coarsely Woven Fibres.

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A Secret Davenport Phonograph Is Shown Below. The Phonograph Is Mounted in One End; the Record Cabinet Is Placed in the Other.
This Camera and Collapsible Phonograph Is Just the Thing for Week-Ends and Camping Trips.
MOTOR
TONE ARM
CLOSED 11" x 10" x 4"
The Ever-Playing Phonograph Shown Above Plays One Record After Another Automatically, the Tone Arm Shifting Back and Forth After the Playing of Each Record.
Compact Air Phonograph Which Gives the Full Original Volume of Sound Produced by the Singer or a Band.
STEEL MAGNET ARM
NEEDLE
BALL JOINT
PHONOGRAPH NEEDLES
CUP
A Recent Innovation in Phonographs Is This Machine, Which Fits in the Corner.
No Sticking Your Finger Now—Thanks to the Magnetic Needle Server Here Illustrated.
This New Reproducer Utilizes Vibrations from Both Sides of Its Wooden Diafram, a Metal Horn Being Fitted on Extra.

New Tricks in Phonographs

THE phonograph profession, if we may call it so, seems to have settled down during the past few years to a very orthodox level and nothing radically new has been brought out by the manufacturers. Lately, however, a few interesting innovations in the phonograph world have been evolved and the accompanying illustrations show some of these.

Have you seen the new magnetic needle-service cup? The needle cup resembles the usual one found on the ordinary phonograph, but at one side there is formed a ball and socket joint, and from this joint projects a short magnetized steel arm. The steel is covered with a nickel plated brass sleeve, so that only the pointed tip of the steel projects, in order that but one needle will be picked up at a time, when the point of the arm is deprest down into the needle cup. This will prevent pricking your finger with the needle which frequently happens with the ordinary receptacles.

A Yankee inventor of Ridgewood, N. J., has developed something quite unique in phonograph cabinets—one that fits in your parlor corner—and which, besides saving considerable space, distributes the music more evenly all over the room. This idea is shown in one of the accompanying illustrations.

Another genius has perfected a combined camera and phonograph device which will appeal to campers particularly. The whole affair folds up very compactly to about the size of a lunch box, and it plays very well indeed.

The davenport phonograph represents one of the best ideas we have recently seen. The record cabinet is concealed on the left hand side of the davenport, while in the right hand side we find the phonograph. An electric light with chain socket is provided, which may be supplied with current either from a battery hidden in the phonograph compartment, or else from the usual 110 volt lighting circuit.

The self-playing phonograph here illustrated will play a dozen records or more over and over if you so desire, and by adding more racks, as many records as one wishes may be played one after the other automatically, provided the phonograph is fitted with an electric motor, or it will play as many records as your spring motor will ordinarily take care of. In playing the machine with this attachment, a selection of records is placed on the turn-table, then all but one are raised by hand and inserted in the locks held up

(*Continued on page* 650)

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Have We Neighbors in Space?

By IVAN L. SMITH

IT is doubtful if any human being, whose intellect rises above that of the instinct-governed beast, can contemplate the star-studded heavens on a clear night without being imprest with a sense of man's insignificance, individually and as a race. Knowing that, except for the few planets, each brilliant point of light is a sun, possibly of sufficient size to dwarf our own luminary into pigmy proportions; knowing that each sun, gigantic or small, probably has attendant planets of varying size and number; and knowing that countless of the visible suns are composed of the identical elements common to the Earth, the Sun, and other members of the solar system; the observers' belief in the age-old theory, that our own earth, a mere speck of dust in the boundless universe, is the only globe destined to be inhabited by rational creatures; is bound to totter. As well assume that "in a hotel of hundreds of millions of rooms, only one little hall bedroom has a guest."

Astronomers investigating the question of a multiplicity of habitable globes have reached varying conclusions. Only the members of our immediate solar system are sufficiently close for the telescopes, now in existence, to show them as discs; and even among these near neighbors, study of the surface is impossible except in a few instances. The investigators, consequently, did not have a large number of bodies available for investigation. A study of the Moon's surface seemed to show that it was a dead body in every sense of the word. Other bodies, such as Jupiter, Saturn, the Sun, Venus and Mercury, were placed in the improbable class for one reason or another; and Uranus and Neptune are too far removed to be studied.

Only one globe, of those available for study, seemed to show evidence of habitation. Mars, the little red planet and our next door neighbor in the solar system, is the only body which thus far has rewarded the searchers with evidence of an affirmative nature.

Professor Percival Lowell, after long study of this body, made the announcement that it was inhabited, and backed his assertion with convincing proof. A few astronomers supported him in his belief, but a far larger number, possessed of conservatism to a superlative degree, attempted to tear down his structure of logic. The argument between the factions has been long, intense, even bitter. It is still in progress. It would be impossible in an article of this length to go into both sides of the question. It is the intent to merely give a few of the more telling points advanced in favor of the theory of habitability. The reader who wishes to go into the subject more fully is respectfully referred to three very learned books publisht by Prof. Lowell—"*Mars*," "*Mars and Its Canals*," and "*Mars as the Abode of Life*." He was undoubtedly the leader in the investigation; his death occurred a short while ago. The writer is indebted to him for most of the material contained in this article.

In treating this subject Prof. Lowell attacked it from two angles. First, he proved by analogy that life on Mars was *possible;* then he detailed the evidence that life actually *existed* there.

If it were proven that surface conditions on a planet supposed to be inhabited were almost identical with those on a planet known to be inhabited, then the supposition that both planets were inhabited would be well founded. Surface conditions on Mars resemble terrestrial surface conditions to a remarkable degree.

Our terrestrial day is 23 hours 56 minutes in length. Study of a prominent land mass on Mars showed that the planet required 24 hours 37 minutes 22.1 seconds to complete one axial revolution, and this figure consequently has been generally accepted as the measure of the length of the Martian day. The close similarity of the Martian day to our own is at once apparent. Furthermore, a comparison of the inclination of their respective axes to the planes of their orbits (Mars 25°, Earth 23° 24′) shows another striking similarity. As the axial tilt governs the difference in the length of summer and winter days, it will be seen that the Martian day and night resemble our own strikingly in length, both from day to day and from season to season.

The greater distance from the Sun and the consequent lengthening of its orbit have given Mars a year differing from the terrestrial year. The Martian year consists of 687 days, practically twice as many as our own, but when we consider some of the outermost planets, whose years equal many Earth-years, this difference becomes of slight importance.

Since seasonal features are determined by the axial inclination and the length of the year, it will be seen that the Martian season resembles our own closely, except in the matter of length. Winter and summer appear alternately in the northern and southern hemispheres, just as we find them doing on Earth, and the torrid, temperate and frigid zones have nearly the same comparative width. Lowell has determined the division of the year into seasons to be as follows: Spring 199 days, summer 183 days, autumn 147 days, and winter 158 days. The lengths, as will be seen, differ from that of the seasons we know, but the proportions are about the same.

To all forms of life, of which we can have any conception, the prime requisites for existence are air and water. The fact that snow congeals at the poles of Mars in winter and thaws in summer, is only one proof that Mars has an atmosphere. Water-vapor could not be conveyed to the poles and there deposited as snow and frost by any other agency. Refraction of light through the air at the planet's edges results in a "twilight arc," which was inadvertently measured when measurements were being taken of the globe. The air is remarkably free from clouds, but clouds do materialize occasionally, as an obscuration of the planet's face is mentioned by Lowell, attributed to clouds, which measurements showed to be fifteen miles above the surface. Without taking up the point in detail at this time, certain areas prove themselves to be covered with vegetation, since they show progressive seasonal change. The presence of vegetation argues the presence of carbon-dioxid and oxygen, since one is a necessity for plant growth and the other is a product of plant life.

The question of water supply is answered for any one, who can obtain the use of a moderate sized telescope. The most prominent features on the planet's surface, and the earliest recognized, are the dazzling white snow caps which cover the polar areas. In midwinter the southern polar cap stretches unbroken over 2,000 miles of the planet's surface, and was easily seen by the writer with a six-inch glass. With the approach of the Martian spring the cap begins to contract, and during the contraction is surrounded by a blue band, which recedes as the snow-line recedes and which varies in width in proportion to the rapidity of the melting. Various tests prove conclusively that the band is water, and that, consequently, the polar caps consist of snow or ice.

When you mention the polar caps, however, you have completely catalogued the Martian water supply. Seas are noticeable chiefly because of their absence. Certain areas, darker than the surrounding surface, were long regarded as seas and were even named as seas. The "seas," however, refused to stay seas and by their very unmarinelike behavior betrayed their waterless state. In the first place, they change color from season to season; again, their extent varies to a certain degree from time to time; and finally, it was discovered that permanent lines cross their surface. No self-respecting sea will allow permanent markings on its face; and therefore, we must look upon the

(*Continued on page* 659)

Feature December Articles

How Phonograph Records Are Made—The Inside Secrets Explained at Last. Fully Illustrated With Photos. By Alexander H. Kolbe.

Utilizing the Interior Heat of the Earth. By C. S. Corrigan.

Electrolytic Destruction of the Teredo—An Applied Process Which is Destined to Save Thousands of Sub-Aqueous Sheathing and Piling Annually.

"Without Residue," a Clever Scientific Detective Story. By Charles S. Wolfe.

Impact Process for Making Gasoline—A New and Cheap Method of Making Gasoline, Which is in Successful Operation. By D. C. Miner.

The Motor-less Airplane—Is Man Learning to Fly Like the Bird at Last? Actual Flight of 5¼ Miles Described by Stanley Yale Beach, Ph.B.

Ice Boats and Speeders—How to Build Them. The Greatest Sport of all Time. By P. P. Avery, M. E.

The Making of Plate Glass—Well Illustrated. By Robert G. Skerrett.

Cold Light from Sunshine. By L. B. Kirby.

Fortunes from Little Things. By Charles Frederick Carter. Don't Miss This Series—It May Mean Your Fortune.

Insects as Jewelry. By Dr. Ernest Bade.

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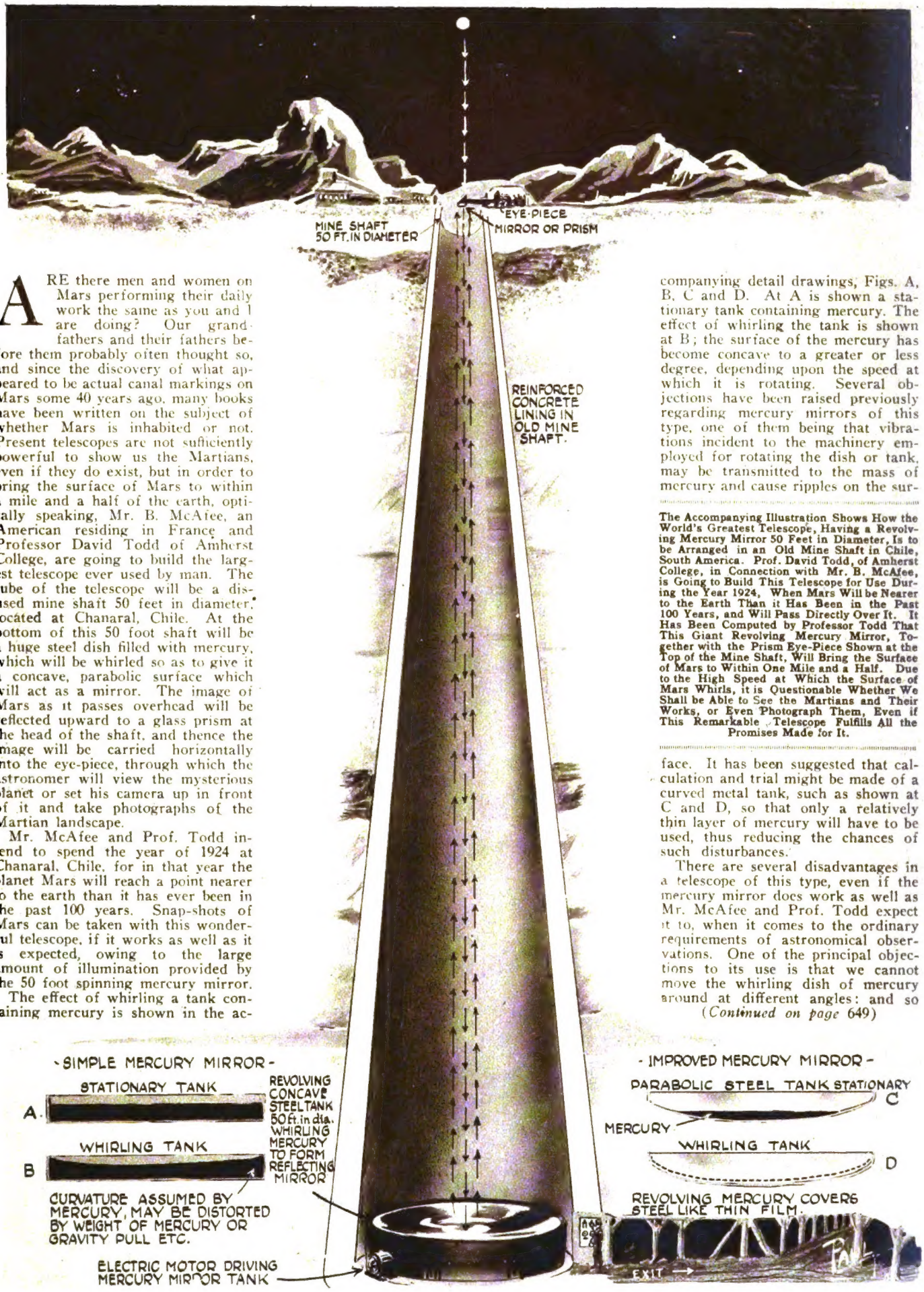
Mercury Mirror to Bring Mars Close


MINE SHAFT 50 FT. IN DIAMETER
EYE-PIECE MIRROR OR PRISM
REINFORCED CONCRETE LINING IN OLD MINE SHAFT.
- SIMPLE MERCURY MIRROR -
STATIONARY TANK
A
REVOLVING CONCAVE STEEL TANK 50 ft. in dia. WHIRLING MERCURY TO FORM REFLECTING MIRROR
WHIRLING TANK
B
CURVATURE ASSUMED BY MERCURY, MAY BE DISTORTED BY WEIGHT OF MERCURY OR GRAVITY PULL ETC.
ELECTRIC MOTOR DRIVING MERCURY MIRROR TANK
- IMPROVED MERCURY MIRROR -
PARABOLIC STEEL TANK STATIONARY
C
MERCURY
WHIRLING TANK
D
REVOLVING MERCURY COVERS STEEL LIKE THIN FILM.
EXIT

The Accompanying Illustration Shows How the World's Greatest Telescope, Having a Revolving Mercury Mirror 50 Feet in Diameter, Is to be Arranged in an Old Mine Shaft in Chile, South America. Prof. David Todd, of Amherst College, in Connection with Mr. B. McAfee, is Going to Build This Telescope for Use During the Year 1924, When Mars Will be Nearer to the Earth Than it Has Been in the Past 100 Years, and Will Pass Directly Over It. It Has Been Computed by Professor Todd That This Giant Revolving Mercury Mirror, Together with the Prism Eye-Piece Shown at the Top of the Mine Shaft, Will Bring the Surface of Mars to Within One Mile and a Half. Due to the High Speed at Which the Surface of Mars Whirls, it is Questionable Whether We Shall be Able to See the Martians and Their Works, or Even Photograph Them, Even if This Remarkable Telescope Fulfills All the Promises Made for It.

ARE there men and women on Mars performing their daily work the same as you and I are doing? Our grandfathers and their fathers before them probably often thought so, and since the discovery of what appeared to be actual canal markings on Mars some 40 years ago, many books have been written on the subject of whether Mars is inhabited or not. Present telescopes are not sufficiently powerful to show us the Martians, even if they do exist, but in order to bring the surface of Mars to within a mile and a half of the earth, optically speaking, Mr. B. McAfee, an American residing in France and Professor David Todd of Amherst College, are going to build the largest telescope ever used by man. The tube of the telescope will be a disused mine shaft 50 feet in diameter, located at Chanaral, Chile. At the bottom of this 50 foot shaft will be a huge steel dish filled with mercury, which will be whirled so as to give it a concave, parabolic surface which will act as a mirror. The image of Mars as it passes overhead will be reflected upward to a glass prism at the head of the shaft, and thence the image will be carried horizontally into the eye-piece, through which the astronomer will view the mysterious planet or set his camera up in front of it and take photographs of the Martian landscape.

Mr. McAfee and Prof. Todd intend to spend the year of 1924 at Chanaral, Chile, for in that year the planet Mars will reach a point nearer to the earth than it has ever been in the past 100 years. Snap-shots of Mars can be taken with this wonderful telescope, if it works as well as it is expected, owing to the large amount of illumination provided by the 50 foot spinning mercury mirror.

The effect of whirling a tank containing mercury is shown in the accompanying detail drawings, Figs. A, B, C and D. At A is shown a stationary tank containing mercury. The effect of whirling the tank is shown at B; the surface of the mercury has become concave to a greater or less degree, depending upon the speed at which it is rotating. Several objections have been raised previously regarding mercury mirrors of this type, one of them being that vibrations incident to the machinery employed for rotating the dish or tank, may be transmitted to the mass of mercury and cause ripples on the surface. It has been suggested that calculation and trial might be made of a curved metal tank, such as shown at C and D, so that only a relatively thin layer of mercury will have to be used, thus reducing the chances of such disturbances.

There are several disadvantages in a telescope of this type, even if the mercury mirror does work as well as Mr. McAfee and Prof. Todd expect it to, when it comes to the ordinary requirements of astronomical observations. One of the principal objections to its use is that we cannot move the whirling dish of mercury around at different angles: and so

(*Continued on page* 649)

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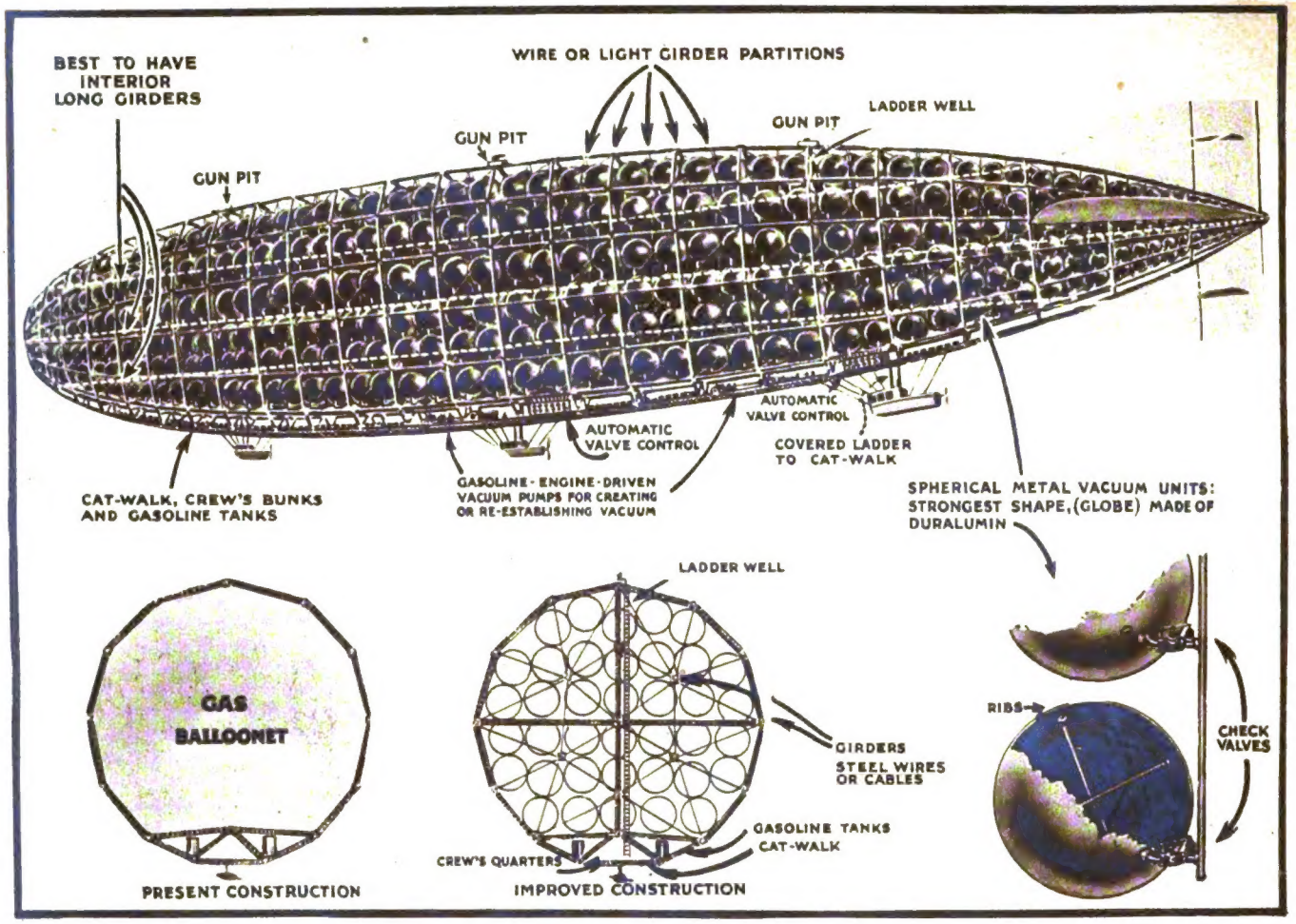

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Since the Deplorable Disaster which Befell the ZR-2 Dirigible in England, which Accident was Described at Length in Our October Number, Danger from Future Explosions or Fire Due to Filling Airships with a Combustible Gas, has Caused Inventors and Engineers to Strive to Develop a Safer Method of Building a Lighter-Than-Air Flying Craft. The Illustration Above Shows Some of the Outstanding Features in Designing a Vacuum Airship, while the Merits and Demerits of Such a Dirigible as well as Its Lifting Power Compared to the ZR-2, are Discust in the Article Presented Herewith.

Is the Vacuum Airship Practical?

By H. WINFIELD SECOR

RECENT dispatches from Paris and other European points have excited the minds of aviation enthusiasts by the news of a wonderful new lighter-than-air flying machine which is said to be under construction at Naples, Italy. Unlike the ill-fated ZR-2 and other dirigibles, including the Zeppelins built by the Germans, this new Italian airship is said to employ no gas at all—but instead a vacuum. In other words, all we are supposed to do to make this machine a success is to have suitably strong compartments and to exhaust the air from these when the airship will supposedly rise. Of course this phenomenon is based on the scientific fact that air does have weight; and to be exact the weight of ordinary dry air is given by Professor Humphreys in his *Physics of the Air* as 565 grains, or 1.29152 ounces per cubic foot.

Thus with a flying machine of the dirigible type said to have been invented by two Italians, Vaugeau and Gargiulo, and built large enough to have a capacity of 2,000,000 cu. ft., similar to the large British dirigibles, by simple computation, we find that if we exhaust this airship of its 2,000,000 cu. ft. of air we would create a total lifting effort of 161,250 pounds, equivalent to 80.6 tons. It is well to remember at this point that the lifting power of the ZR-2 was about 50 tons. So far the vacuum airship sounds like a good proposition, but we are confronted with the cold fact that from this gross lifting power of 80½ tons, we will have to deduct the weight of the airship itself, and it looks very much to us as if, when this is done, our net useful lift will be somewhere around the zero point.

Stop to think for a moment just what kind of construction will have to be employed in building compartments capable of being exhausted to almost a perfect vacuum. You will remember that our physics books taught us that unless a chamber was very strong, it would collapse, due to atmospheric pressure, when a perfect vacuum was produced. Of course we cannot create a state of perfect vacuity even in the laboratory to-day, with our finest condensation and molecular pumps, and it will probably not be possible to create a very remarkable vacuum in the airship compartments. It would thus seem that after we have built an airship with compartments strong enough to withstand the outside atmospheric pressure when the air is pumped out of them (there will undoubtedly be only a fair degree of vacuum produced in the compartments), we can hardly expect the airship to rise, even if it only has to carry up its own frame.

The accompanying illustration shows several ideas which would apply in designing a practicable vacuum airship. First it would seem almost impossible to provide very large vacuum chambers, and it would seem advisable that these be formed rather small and of spherical shape, for we know that a sphere presents the greatest strength of any geometrical shape. These spheres may be made of a light metal such as duralumin with ribs or braces inside of them for additional strength, and they might be arranged in groups, as shown in the illustration. All of the spherical compartments in one group would be joined together by suitable pipes fitted with check valves, and at the bottom of each compartment a pipe would lead to a central control board, where gasoline-engine driven vacuum pumps would connect with the pipe lines to exhaust the air from the chambers. Instead of carrying sand or water ballast for raising and lowering the airship, more or less air could be taken from the vacuum chambers fore and aft, so that the airship would lower or raise its nose correspondingly. Automatic vacuum valves could be arranged on the control boards so that, during a voyage when any of the vacuum compartments might need re-exhausting, this will be done automatically.

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Ultra-Violet Light—Its Uses

By PROF. T. O'CONOR SLOANE, Ph.D., LL.D.

Ultra-Violet Rays are Produced in Large Quantities from Cooper-Hewitt Mercury Vapor Lamps of the Type Here Shown in the Center and Lower Left-Hand Cuts, the Tube Being Made of Quartz Glass, Which Permits These Rays to Pass Practically Without Absorption or Reflection. The Upper Right-Hand Photo Shows Ultra-Violet Ray Generator Being Used for Treatment of Skin Blemish, While the Upper Left-Hand Photo Shows Small U. V. Applicator Being Used for the Treatment of Infected Tonsils. Lower Right-Hand Photo Shows Quartz U. V. Tube Employed for Testing of Cloth Samples, Whereby the Effect of One Year's Sunshine on the Dyes and Fabric Is Obtained in a Few Days.

MAN'S acquaintance with the world of matter is largely dependent on waves; for sight and hearing address the mind, only when the eye and the ear are acted on by waves. The large and the small reveal themselves to him in air waves and ether waves, the first affecting the organs of hearing, and the latter the organs of sight. Ether waves which started from distant stars many years ago, will act upon the retina of the eye any night, when we look at the sky, and will tell us not what is there now necessarily, but what was there generations ago. The grosser waves of air, acting on the human ear, give the sensation of sound. The scope of the human eye and of the human ear may be based upon the relations of the rate of vibration or of the periodicity of waves, which affect each of the two senses. The musician appreciating and placing notes of music, producing them from a keyless or unfretted instrument, without knowing that he does anything wonderful, performs a marvelous feat of pure mathematics. For the musical scale is based upon the number of waves per second, corresponding to each of its notes. The fractional and reciprocal correspondences of notes are based on numbers originally simple, but which become more complicated as we go up the scale. To get the harmonic or agreeable relation of sounds, which produce music, a scale is divided into octaves, each octave as we go up having exactly double the number of vibrations of the one below it. The range of hearing without attempting any particular feats, may be taken as ranging from 16 to 52,576 vibrations per second. This is 12½ octaves. When a musician picks out a note and names it, it may be the assertion that the note gives 692 vibrations per second, or if it is an octave higher he will virtually say that it gives 1,384 vibrations per second. In this way picking out the notes on the scale, he will name the number of vibrations per second, and by merely playing by ear, as with a violin, he will produce vibrations of the air, correct to the twenty-thousandth part, or still more minutely defined. This is a wonderful feat.

If we go an octave below 16 vibrations per second, we have 8 vibrations per second, and this does not produce a note, but simply gives us the sensation of a rapid succession of sounds. If we go much above 50,000 vibrations per second we hear nothing. There is little doubt that insects hear many sounds of a pitch higher than any rate within the limit of generation, traversed by wireless mes-

(Continued on page 667)

We will now look into ether waves produced by luminous and non-luminous bodies. These come thru space with an enormously high rate of vibration. Confining ourselves to the ratio of vibrations, we find that the human eye is affected by about one octave; if the ear had a similar range of power to that of the eye, our musical compositions would be of the last degree of simplicity. The longest waves which affect the eye are those of red light. The shortest waves, on the opposite end of the spectrum, are those of violet light. The violet light waves vibrate about twice as rapidly as the red, so it is fair to say that the visible spectrum, which includes all the light which affects the human eye, covers about one octave. But the ether is kept busy vibrating at other rates than the one just specified; slower waves radiate into space and produce heat; a coal stove (which is quite black and invisible in the dark) will be felt emitting heat against the hand held near it, and this occurs by invisible ether waves which cannot affect the retina. Other very long waves carry the messages of radio stations. If the waves of wireless telegraphy were not too long to affect the optic nerves, the atmosphere of this

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Earthquakes Made to Order

EARTHQUAKES are not of such frequent occurrence, for which we are duly thankful, that motion picture photographers can dash about and snap the majestic scene of rock and dirt being blown skyward, while a white-hot adjacent volcanic crater vomits forth boiling lava. Hence and wherefore, we have with us something brand new now in motion picturedom—the earthquake made to order.

The accompanying illustrations show clearly how the artificial volcanic and earthquake effect was staged in photographing a recent motion picture scene produced by an American photoplay company. The limit of vision for the battery of motion picture cameras is indicated by the lines A-A in the picture. A first-class earthquake with accompanying volcanic eruption was produced

This Volcanic Eruption and the Accompanying Earthquake Represents the Highest Pinnacle of the Motion Picture Art. A Small Hill Was Used to Build the Volcano on, Rocks and Dirt Being Blown Skyward With the Usual Smoke and Dust, by Means of Steam Shot Thru Jets Placed in the Crater of the Made to Order Volcano, as the Illustration Clearly Shows. The Molten Lava Which Flowed Down the Crevices of the Volcano Was Composed of a Solution Resembling Whitewash, Forced Out of the Pipes by Steam Pressure at a Boiling Temperature. The Earthquake Effect Was Realisticall Duplicated by Pulling Triangular Shaped Earth Sections to One Side, by Means of Motor Tractors, While the Flimsily Built Houses Collapsed and Started to Burn.

ARTIFICIAL CRATER FILLED WITH STONES AND DIRT OVER STEAM PIPES
SMOKE DAMPER
FISSURES COVERED WITH CANVAS AND DIRT UNTIL SECTIONS ARE DRAGGED APART
DIRECTOR, CONNECTED BY TELEPHONE WITH CAMERAS
LARGE TANKS CONTAINING WHITEWASH FOR "MOLTEN LAVA" EFFECT; HEATED AND FORCED OUT BY STEAM PRESSURE
POWER PLANT
A-A LIMIT LINES OF CAMERAS
HOUSES
CAMERAS
ARTIFICIAL FISSURES, DOWN WHICH "MOLTEN LAVA" FLOWS
TRACTORS
REAR VIEW SHOWING APPARATUS

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in this scene, and in a relatively simple manner at that. Several platforms were arranged on wheels so as to be movable along tracks for a short distance as the picture shows at the left. Each of these platforms had a section of earth represented on it by a framework which was covered with paper pulp and fabric suitably painted; when all of these sections were pulled to the left by the automobile tractors at the director's signal, the effect of ever-widening fissures or chasms in the earth was produced in a startlingly realistic manner. Pieces of canvas were placed across any open junctures between the platform sections and loose soil placed over them. Next the buildings, which were erected in a specially flimsy manner, fell down when jarred, and when certain support sticks were pulled from under by hidden wires, all of the terrors of a devastating earthquake and volcanic eruption were evolved with remarkable fidelity.

A few hundred actors and supers dashing about wildly over the crevices, coupled with falling buildings and the white hot lava trickling down the sides of the mountain in the background, all helped in producing this wonderful motion picture. Even the dense clouds of smoke which usually accompany volcanic eruptions were produced by the artificial volcano.

One of the accompanying illustrations shows a sectional view of the movie-made volcano which poured forth rocks, dirt, smoke and lava, all in bounteous profusion, at the critical moment when the director-in-chief gave the order, his assistant directors in various parts of the second being connected with his station by telephone. Steam boilers supplied both smoke and steam, which shot upward from the crater at the top of the volcano, suitable valves and dampers being provided for the control of the effects.

If you have ever seen a steam or compressed air pipe, or even a high pressure water pipe discharge into loose dirt and stones, you will have a vivid idea of how this volcanic eruption was made to order. The top of the crater was filled with loose rocks and dirt and when the steam was turned on, slowly at first, the dirt and smaller stones were shot upward, while the smoke added its accompanying effect. After a few moments the molten lava began to pour down the mountain slopes, just as you remember having seen it do in actual

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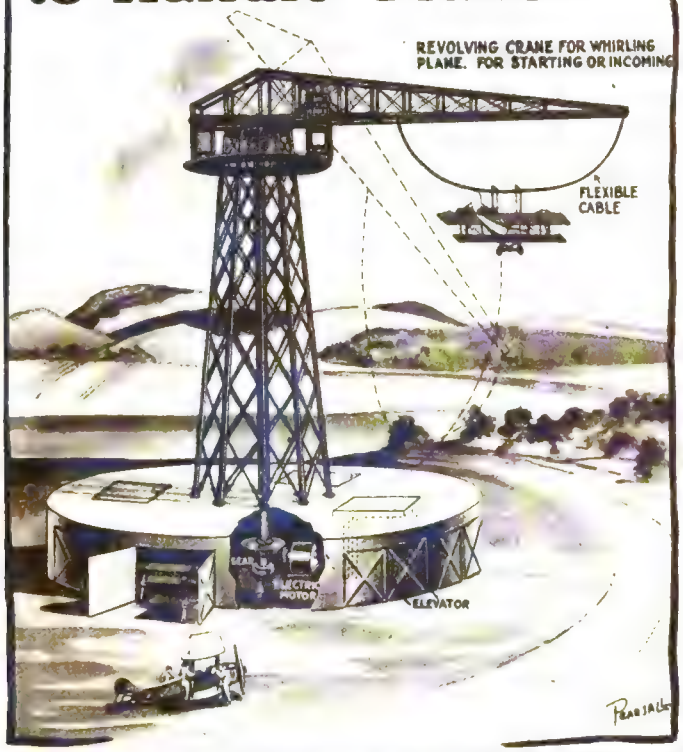
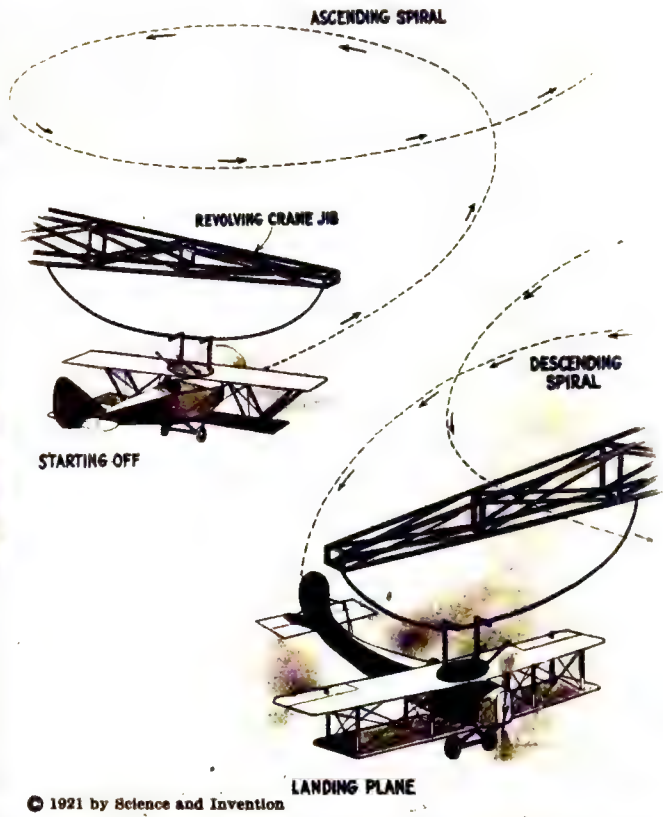
Magnets and Cranes to Handle 'Planes





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The Airplane Landing and Starting Device Shown Above was Recently Patented by an American Inventor. The Principal Use of This Invention Will Undoubtedly be in Crowded Districts. In the Base of the Tower There Is a Storage Space for Airplanes and Elevators Raise Them to the Starting and Landing Platform. The Crane Revolves and Can be Tipt Gradually to Any Angle, the Planes Ascending or Descending in a Spiral in Starting or Landing, as Depicted at the Right.

ONE of the accompanying illustrations shows a scheme suggested by an American genius, one Raymond Noble Coffman, whereby he proposes to accelerate as well as decelerate airplanes, as they move over a revolvable turn-table erected on the top of a high building; all by means of powerful electro-magnets. Several years ago an elaborate article appeared in the pages of this journal describing a scheme for stopping large aircraft quickly, when they had landed, by means of powerful electro-magnets mounted flush with the floor of the aerial platform, similar to the arrangement here illustrated. Mr. Coffman's scheme, however, is somewhat on the order of the electro-magnetic gun, in that he proposes to rapidly accelerate or increase the speed of the airplane by exciting the series of electro-magnets one after another in rapid succession. As the electro-magnet just ahead of the airplane is switched on each time, the one over which the plane had just moved is cut out of circuit, and as experiments with electro-magnets have shown, a very rapid acceleration of an object in this manner is readily obtainable. Of course, the airplane engine and propeller would help to shorten the accelerating period considerably. In order that the magnets can act on the plane properly to pull it forward, one after another, there is an iron plate fastened underneath the plane on the landing wheel chassis.

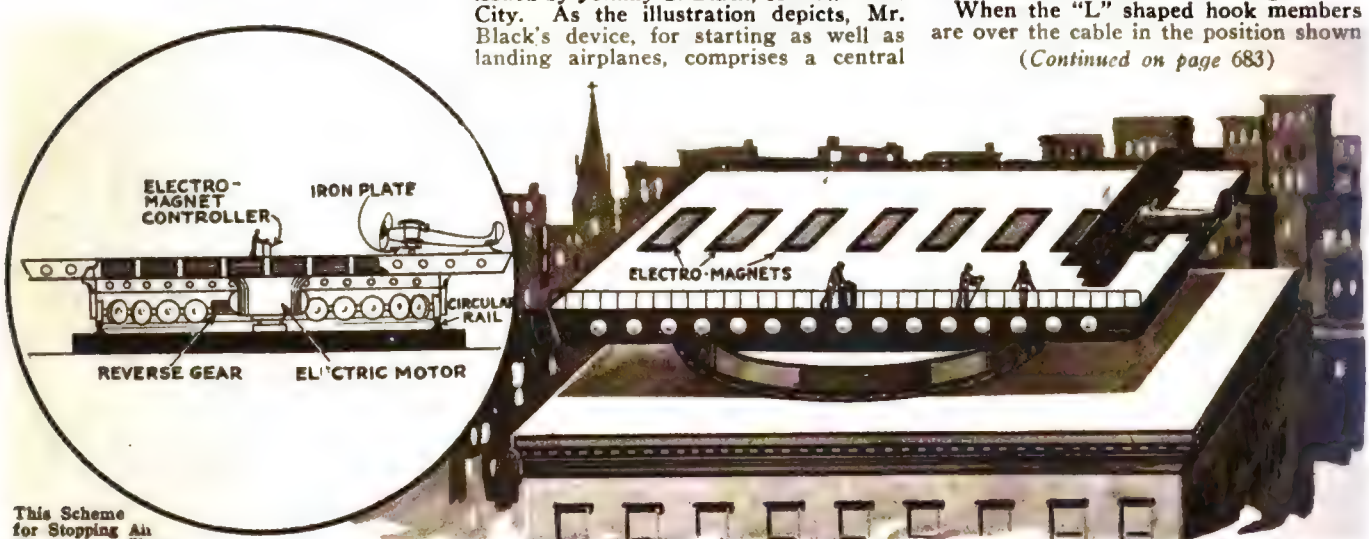
Revolving Crane for Starting and Landing Airplanes

The second illustration herewith presented shows a very ingenious and interesting device on which a patent has been issued by Johnny S. Black, of New York City. As the illustration depicts, Mr. Black's device, for starting as well as landing airplanes, comprises a central tower-like structure, around the upper part of which a balanced jib or crane can revolve. Airplanes which may have landed on the ground, are run in thru the doorways in the base platform, and on to one of the large electrically operated elevators, shown in the picture. By means of the elevator the airplane is raised to the starting and landing deck. A loop of flexible steel cable hangs downward from the outer end of the jib arm in the manner indicated.

Airplanes designed to be started or landed with this machine are fitted with special collapsible hook members, which are clearly shown in the photo. The pilot pulls on two handles, which action raises the hook members, and he revolves the plate on which they are mounted, according to whether it is going to start off or land, as shown in the two detail illustrations at the right.

When the "L" shaped hook members are over the cable in the position shown

(*Continued on page* 683)



This Scheme for Stopping Airplanes on a Short Platform When Landing or Accelerating Them Rapidly In a Limited Space, Involves the Use of a Series of Powerful Electro-Magnets. An Electric Motor Serves to Rotate the Platform to Suit Different Wind and Weather Conditions. An Iron Plate is Mounted Under the Plane for the Magnets to Act Upon, the Magnet Poles and Windings Being Made Flush with the Platform Floor. The Magnets are Excited Progressively to Accelerate a Plane.

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Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

Is the Great Red Spot of Jupiter a Satellite in Embryo?

THE theory has been advanced recently by an English astronomer that the Great Red Spot of Jupiter, the most conspicuous marking seen on this planet during the past forty years and known to have been in existence at least one hundred years ago, is a *satellite* in the making, that it is exerting a strong repulsive force upon adjacent markings in the planet's atmosphere and is probably slowly receding from the parent-mass and is destined to become in a later stage of evolution a tenth satellite of Jupiter, encircling the huge planet in an independent orbit. This Jovian phenomenon is taken to be corroborative of the origin of our own moon from the earth-mass as outlined in the tidal theory of Sir George Darwin.

It may be said in this connection, however, that Darwin, in his later writings, expresses a doubt as to whether the earth and moon could have revolved in close contact at any period in the remote past, owing to the fact that the tidal strains exerted by the earth upon the moon when in that position would have been great enough to completely disrupt the smaller body and transform it into a ring of minute fragments encircling the earth.

A limit of eleven thousand miles, two and four-tenths times the earth's radius, is placed as the closest possible approach of the moon to the earth in past ages in accord with the limit given originally by Roche and known as Roche's limit. This gives 2.44 . . . times a planet's radius as the least distance at which any satellite could resist the tidal strains produced by the attraction of the planet's greater mass. Jupiter has one small satellite, known as Satellite V, about one hundred miles in diameter that lies very close to this limit, its distance from the center of Jupiter being 112,500 miles, which is a little more than two and one-half times the mean radius of Jupiter. The rings of Saturn fall within this limit, the outer edge of the outer ring being only 2.32 times the mean radius of Saturn or 86,300 miles from the center of the planet. The existence of rings, instead of a satellite, within this distance, evidently implies that no satellite could long exist close to the surface of a planet, even granted that it could form within this distance.

If, then, the Great Red Spot of Jupiter is a *satellite in the making*, destined to be launched forth upon an independent career at some future age, it would require some great internal upheaval of the Jovian mass or some form of electrical repulsion or sudden release of subatomic energy within the planet, powerful enough to expel this mysterious formation not merely clear of the Jovian surface, but to a distance of at least one hundred and ten thousand miles from the center of the planet.

Otherwise Jupiter would be presented with a ring system similar to that of Saturn, rather than with a new satellite. There is no evidence at present to the effect that any such force is forthcoming or that any cataclysmic change is to take place within the mass of Jupiter. To expel an object from the surface of Jupiter, so that it would revolve around the planet in circular orbit, close to the surface, would require an initial velocity of ejection of twenty-six miles a second. This is a velocity considerably greater than that of the earth in its orbit. In fact, if such a velocity were suddenly imparted to the earth in its orbit, it would escape the control of the sun and leave the solar system never to return.

No protuberance or freely floating mass in the atmosphere of Jupiter, we feel safe in saying, could ever, even with the aid of external forces, detach itself gradually from the planet and take on the form of a neatly-fashioned spherical attendant of the great planet revolving close to its surface in independent orbit. Even if it should resist and eventually overcome the strong gravitational bonds that bind it to the giant planet, aided by cen-

SEVERE INTERNAL UPHEAVAL (OR EXTERNAL ATTRACTION) CAUSING STREAM OF MATTER TO BE SHOT OUTWARD ---
WHIRLING MASS SHOT OUT AT TREMENDOUS VELOCITY FORMING SATELLITE, ACCORDING TO MRS. LEWIS

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The Author of the Present Article Does Not Agree with the English Authority Who Recently Stated That the "Great Red Spot" of Jupiter Has Lifted Itself from the Surface of the Planet and Undoubtedly Represents a New Satellite in the Making. Her Theory and Explanation of the Whole Phenomenon Being Firstly—That There has been no Recent Notable Change in the "Great Red Spot" of Jupiter and it is not Possible for a Moon or Satellite to be Formed by a Gradual Expulsion of a Combination of Particles Leaving the Surface of the Planet. Secondly—That the Known Laws of Astronomy Tend to Prove that the Satellites of Jupiter Were Undoubtedly Formed from the Mass of the Parent Planet Instantaneously by the Ejection of a Stream of Matter Shot from the Planet Under the Influence of Some Great External Attractive Mass, or Otherwise Thru Some Internal Cataclysm, Which Released the Material for the Creation of the Satellite Worlds.

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The Illustration Herewith Shows the "Great Red Spot" of Jupiter and Also the Relative Size of Our Earth Compared With It. It Is Contended by an English Astronomical Authority That the "Great Red Spot," Noticed on the Surface of This Planet for Many Years, Has Recently Shown Unusual Activity, and That in Fact, the "Great Red Spot" Had Lifted Itself Above the Surface, Giving Rise to the Supposition That a New Satellite Was About to be Formed. The Protuberance Would Seem to Indicate that a New Satellite or Moon Would Shortly Appear and Start Circling About the Planet, He Says! The Author of the Present Article Does Not Agree With This Theory and States That if Such Phenomenon Should Occur, the Tremendous Tidal Strains Acting on a Satellite, Formed so Close to the Surface of the Planet, Would Absolutely Tear It to Pieces or Disintegrate It. Her Theory as to How the Satellites of Jupiter Were Formed, Is Illustrated in the Picture on the Opposite Page, and She Also Mentions That American Astronomers Have Not Noticed That the "Great Red Spot" of Jupiter Had Apparently Lifted Itself Above the Surface.

trifugal force, and possibly by a strong electrical repulsion exerted against adjacent markings, as well as by the tidal attractions of four satellites of Jupiter of considerable size, *it would still be subjected to powerful tidal strains due to its nearness to the planet, and as a result it would be completely disintegrated and distributed in ring form around the huge planet,* as a punishment for attempting to free itself from the gravitational bonds that bind it to the surface of Jupiter.

Let us consider briefly just what is known concerning the nature of the Great Red Spot of Jupiter which first attracted the attention of modern astronomers in 1878, tho there is evidence that the object existed and was observed at least one hundred years ago. When first noted in 1878 the Great Red Spot was a pale pink oval about 7,000 miles wide and 30,000 miles long in Jovian latitude about 25 degrees south. It was just south of the south equatorial belt of Jupiter and it appeared almost as if a place had been scooped out for it in this position. It has remained in the same latitude and in the same position relative to the south belt ever since, but has slowly drifted about the planet, and is by no means a *fixt* marking. It belongs beyond a doubt in the atmosphere of the planet, and is not attached to the surface of Jupiter. It is very doubtful, in fact, whether the planet has any surface in the ordinary meaning of the word. The density of Jupiter is only one and one-fourth times that of water. Far beneath its dense atmospheric vapors may be concealed a certain form of surface, a pasty nucleus, possibly, of semi-solid matter comprest into that form thru the tremendous pressure exerted by the dense gaseous layers above. All markings observed upon this planet originate in the planet's atmosphere. The surface, if it exists, is completely concealed far below the dense atmospheric vapors. In this gaseous envelope of Jupiter appear many rapidly-moving spots, white, red, brown, and, at times, even blue and green in color. All of these spots are *transitory.* No marking in the atmosphere has ever attained as great permanency as the Great Red Spot, or anywhere near as great size. Aside from the Great Red Spot the most permanent feature of the Jovian surface are the belts which consist of gaseous vapors drawn into positions parallel to the planet's equator by strong currents arising from the rapid axial rotation of the planet. These also are more or less transitory for they change in number, width, and color. There are three distinctive belts that generally persist however greatly the others may change. These are the equatorial belt which is about ten thousand miles wide and light-colored, and the north and south equatorial belts of nearly equal width but much darker in color, at times appearing strongly reddish or even brown. It is a peculiarity of the Jovian atmosphere that the equatorial regions rotate in a shorter period than

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The Filled Tooth

By CHARLES S. WOLFE

A PUCKERED frown of concentration furrowing his brow, Hazard sat at his little work bench. Despite the raised window and the fact that he was coatless, he was perspiring uncomfortably. The merciless sun of a midsummer afternoon was beating down on a parched earth, and the frame shop, with its tar-papered roof, was a veritable oven. The dog at his feet lay open mouthed, panting.

Yet, engrost with his task and his thoughts, Hazard gave little heed to his surroundings. Magnifying lens held tightly in the socket of his eye, he worked carefully, patiently, taking skillful, microscopic cuts from the small object held firmly before him by the jeweler's vise. Often he paused to take tedious measurements with the most delicate of micrometers.

His thoughts raced ahead of his cautious fingers to dwell on the fast nearing moment of completion and the tense hour of trial. For the thousandth time he reviewed his plans for what was to come, reviewed them in the minutest detail. They seemed perfect, flawless. Yet he went over them again and again, searching for a weak spot which he fervently hoped he would be unable to find. He did not wish to alter any of the arrangements. And yet—this business of killing a man called for infinite precautions, faultless technique.

The price of a slip was too appalling to contemplate. Not the death penalty—he was not afraid to die. But to be, taken would render useless all these months of effort, nullify the two years of planning, rob him of his triumph.

At the thought of triumph his face, which had unconsciously hardened, softened, and a sad smile flickered for an instant across the rather sensitive mouth. "Sylvia! Little lost sweetheart!"

And as her image flitted across his brain and was gone, the features hardened again, and unconsciously his fists clenched. For he was living over again the hour of his defeat, that awful, unbelievable hour when he had stood helpless and saw her joined at the altar to this—this—this other man; the hour that had transformed him from a good-natured, generous, playful young chap into a brooding, dangerous thing, murder bent.

He had told her on the night before the cataclysm, as she lay crushed, sobbing, broken spirited against his breast, that he would sweep this human barrier away, even if he had to kill with his bare hands. And the ghost of her hysterical, pitying, incredulous laugh rang in his ears still, with the memory of her broken words. "You, Dan! You wouldn't kill a kitten!"

She had underestimated him, he thought bitterly, failed—like all the rest, to plumb his depths—and she would continue to underestimate him. She would think that Fate had struck down——.

A sudden, nerve-wrenching thought flashed across his brain. Throwing down the delicate chisel, he sprang to his feet. "What if that accursed dog——?"

He called sharply to the shaggy young collie at his feet—the pup he had so carefully reared and trained for this task. "Come, Ted," he commanded, peremptorily, and strode into the other room of the shop.

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"... Without Ceremony, Hazard Rolled the Collie Over on His Back, Fastened His Legs Securely with Straps, and Inserted a Wedge Between His Teeth.... He then Administered the Anesthetic. Swiftly He Worked Over the Unconscious Dog.... Finally He was Satisfied, the Gaping Cavity was Gone...."

The collie trotted obediently at his heels. Hazard scowled at the row of scarecrow like figures that dangled grotesquely, suspended by cords from the rafters overhead. He walked along the silent row, the dog at his side. Suddenly he applied a quick, almost imperceptible, pressure with his leg against the dog's flank. Like lightning the collie whirled on the unoffending dummy he was passing and sank his teeth viciously into the padded leg. Hazard nodded his satisfaction, and stooped to caress the dog, whose tail wagged the appreciation of the reward. It was the cue which he had spent patient months teaching his pup, the only thing in the whole scheme which he could conceive of as possibly failing him.

Several times he repeated his trip past the dangling forms. Each time the dog's flank felt the pressure of the man's calf, and each time his attack was sudden, swift,

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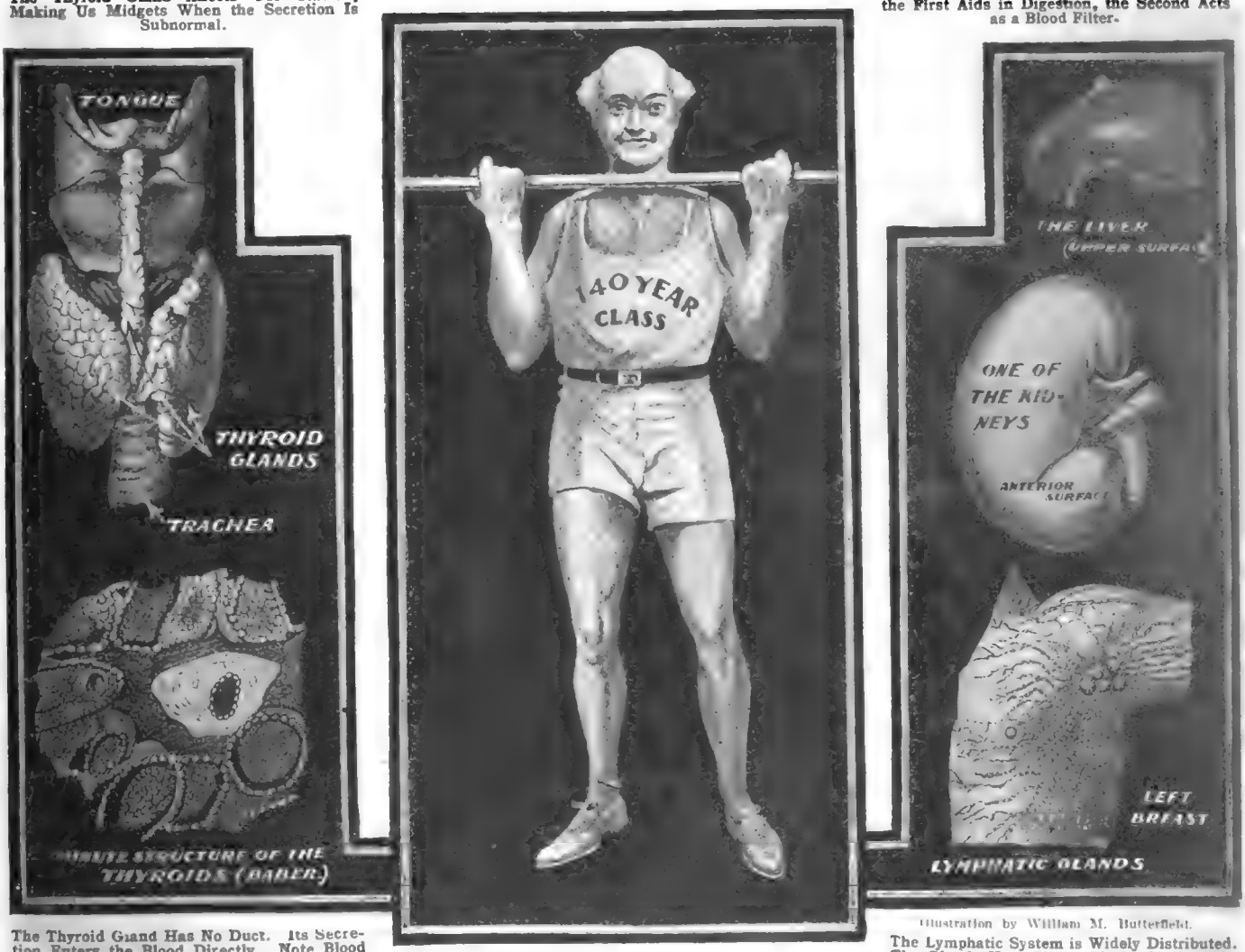
Our Glands—Their Importance to Health

By JOSEPH H. KRAUS

The Thyroid Gland Affects Our Stature, Making Us Midgets When the Secretion Is Subnormal.



The Liver and Kidney Function Differently, the First Aids in Digestion, the Second Acts as a Blood Filter.

The Thyroid Gland Has No Duct. Its Secretion Enters the Blood Directly. Note Blood Vessel in the Enlargement.

Illustration by William M. Butterfield.

The Lymphatic System is Widely Distributed. The Glands Here Shown Lie in the Arm-pit.

YOU have often observed giants and dwarfs at the side shows of the larger circuses and without a doubt wondered how they "got that way." And the answer is *"glands."*

Did you ever stop to consider of what importance our glands are in our system? By way of explanation, let us bear in mind that a gland is a cell or group of cells; in the latter form several may be linked together within a capsule or covering. These glands secrete or eliminate a complex fluid, as a general rule, which fluid serves to perform a variety of functions.

Thus, the kidney serves to remove urea from the blood; the liver furnishes a fluid which assists in the proper digestion and assimilation of food. The lymphatic glands found in the axillary region under the arm, in the region of the thigh and elsewhere in the body, serve to secrete the fluid known as lymph. These latter glands are connected together by a very complex network of tubes and their secretion finally reaches the blood stream, which conveys it to all parts of the body. The ductless glands are however, the most interesting. The glands described above would be clast as having ducts or otherwise tubes, which connect a number of them to one common tube thru which the secretion passes, but in the ductless type, the fluid secreted is taken up by the blood stream entering and leaving the gland.

A Normal Man Compared with Lady Little and Miss Lonney Wagner. The Midget is Claimed to Result from a Lack of Secretion by the Thyroid Gland in Infancy. She Measures 28 Inches in Height, and Weighs 25 Pounds, and is 23 Years Old. Miss Wagner is 7 Ft. 4 In. Tall, and an Over Secretion of the Pituitary Gland Located in the Base of the Skull is the Causative Factor.

The first one of these which we will consider is what is known as the thyroid gland. This is located in the throat and consists of two oval bodies lying side by side on either side of the trachea. These bodies are joined together by a small isthmus. What this gland does with ref-

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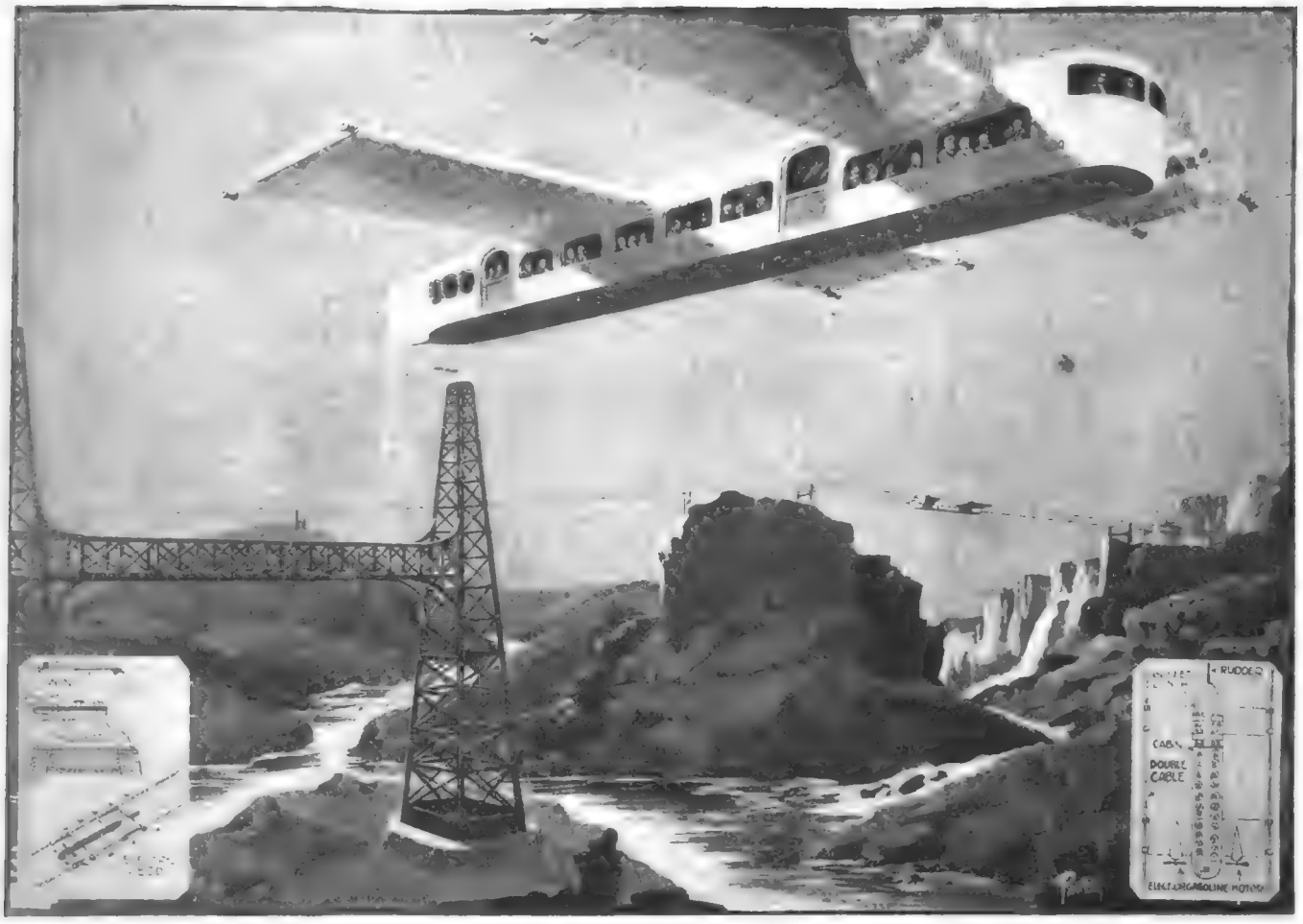
Guided Airplane Makes 150 Miles an Hour



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This Aerial Railway Having Cars Designed Like Airplanes, but With the Advantage That They Are Guided Along Cables Instead of Having to Find Their Way Thru Fog and Storm, Is Actually to be Built in England, Recent European Reports Indicate. The Cars Can Attain a Speed of 150 Miles an Hour Easily, and May be Propelled by Gasoline Engines With the Usual Air Propellers, or else the Propellers May be Driven by Electric Motors, Deriving the Necessary Current from the Wire Cables on Which the Craft Glides. When the Cars Are in Motion There Is Practically no Strain Exerted on the Cables and Towers, as the Wings Will Exert a Powerful Lifting Effect Sufficient to "Float" the Car, While in Rounding Curves the Car Can be Steered by Means of Its Rudder and Tail so as to Minimize Any Strains on the Cables. The Cables Pass Over and Under Alternate Grooved Wheels on the Extremities of the Wings, so that the Cars Cannot Fly Off the Cables, if the Lifting Effect of the Wings Should Become Momentarily Excessive.

IT has been proposed to build an aerial railway, such as shown in our front cover illustration, and also in the accompanying view, in England and other countries, the cars of these railways resembling giant airplanes, and the speed at which they travel approximating 150 miles an hour. This speed should be readily attainable by an aerial car such as that shown in the picture, for the reason that, when the car attains such a speed as 80 to 100 miles an hour, the wings will tend to raise the car in the same way as an ordinary airplane performs. Thus, the car will exert but very little if any pressure due to its weight upon the steel cables along which it travels. In other words, these cables will simply act as guides, in much the same way as General Squier has proposed the use of wires in directing radio waves and currents, which system he terms, *Wired Wireless*.

In the system we are describing, we have a guided aircraft, and judging by the number of accidents which have occurred, especially in stormy weather, when planes have become lost, due to fog and clouds, and have attempted landings in woody sections or other impossible places with disastrous results in many cases, this scheme of providing tracks so to speak, for the airplanes, should prove very welcome. All of the smoothness and speed-abilities of the airplane will be retained and at the same time you will know, when you leave Chicago for example, that you are going to reach the next stop without landing in the top of a tree or some worse place. Besides, airplane engines are not absolutely infallible, and they have a habit of stopping sometimes at very inopportune moments—and when they do stop and they won't start again with the aid of the self-starter or otherwise—there is only one thing for your pilot to do, and that is make a vol-plane landing, and to be mighty quick about it. Of course, the higher the free airplane happens to be, the greater the distance over which the plane can glide before landing, but if you happen to be flying over barren country which frequently occurs, especially with long distance mail and passenger 'planes, you do not always have a good choice of ground on which to land.

It is stated in reports from Europe that they actually expect to build an aerial railway like that shown, and presumably from what information has been given out, the cars will be propelled by means of gasoline engines and the usual propellers. There is another way in which the cars can be propelled and that is by electric motors, the necessary current being supplied from the cables over which the car travels. These cables do not have to be as heavy or as strongly supported as might at first be imagined, for the reason already mentioned, for when the airplane reaches a certain speed, usually about 40 miles an hour, the wings will start to exert a lifting effort and the cars, therefore, will be flying in the air in the same way as if there were no cables at all. But instead of flying free as our ordinary aircraft do at present, these cars will be guided by the cables and will reach their destination with clocklike regularity. These aerial railway cars can be operated in both directions of travel, the cars passing one another side by side, or else one above the other, depending upon the design of the supporting cables and towers. Note that the grooved wheels pass over and under the cables alternately, so as to retain the craft on the wires.

One of the outstanding features of such an aerial railway, which would be a big boon to passenger and freight transportation in any country where large areas of territory are to be served, such as in the central and

(Continued on page 643)

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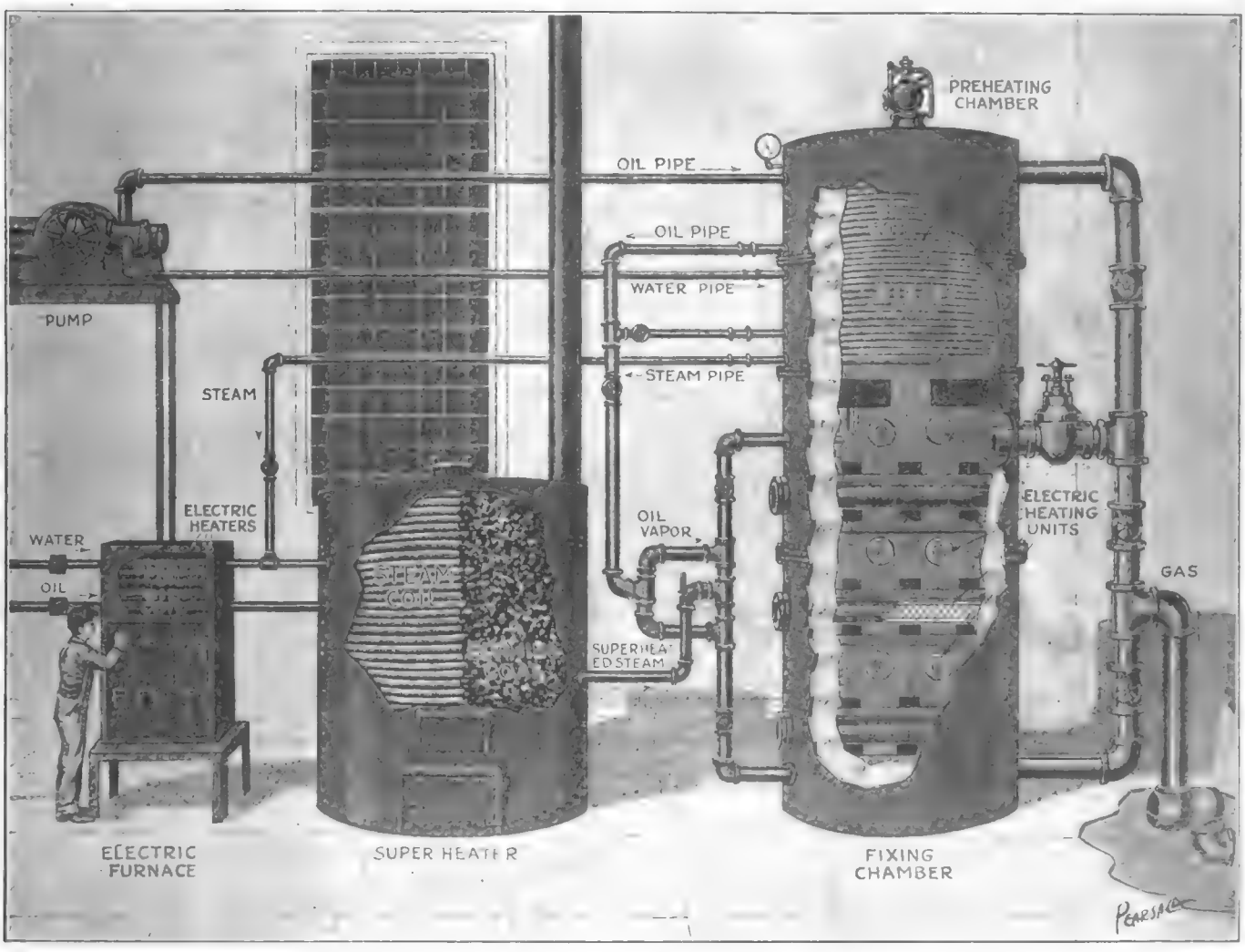
Electric Heat Makes Gas Cheaply

By EDWIN IRVINE HAINES, B.S.

ALTHO the industry of gas manufacture is one of the greatest in the country today, surpassing almost every other in growth during the past twenty-five years, it is a surprising fact that, while designs of existing gas plants may have been slightly improved, or small changes made in their equipment, there has been no material change in the process, or principle, of

Remarkable New Process Which Lowers Cost More Than One-half

The method of operation is briefly as follows: The generator is heated to a required temperature, white heat, and a blast of the hot gases from the generator



Design of Apparatus for the Manufacture of Carburetted Hydrogen Gas by an Electrical Process, Recently Patented by B. Van Steenbergh. The Heating of the Oil and Water by the Electrical Furnace or an Ordinary Boiler is Optional at the Start of the Process. Using the Van Steenbergh Process for Manufacturing Gas, the Cost is Reduced 56.4 Per Cent or More than One-Half. A Plant is Being Fitted with This New Apparatus and Will Shortly be Put Into Operation, Near New York City. It is Said That a Better and More Reliable Quality of Illuminating Gas Can be Manufactured with this Process Than Ever Before, and that the Cost of Production per 1,000 Cu. Ft. of Gas Will be 40 Cents, With the Present Cost of Coal and Other Materials.

manufacturing gas in over a quarter of a century.

About 70 per cent. of the 2,500 gas plants now in operation in the United States utilize what is known as the *Lowe* process, by means of which heating and illuminating gas is produced from the decomposition of steam thru contact and union with carbon at a high temperature, followed by the addition and mixing of oil in a certain proportion, and ignition or heating of the mixture.

The apparatus employed in the Lowe process comprises (1) a generator, or closed cylinder, filled with broken hard coal, (2) a carburetor, or enriching chamber, and (3) another chamber called a superheater, the latter two compartments being filled with cross-layers of common bricks, called checker-bricks.

outlet is forced thru the carburetor and superheater checker-bricks in order to heat them in turn to a high degree, the operation taking about an hour, while a large percentage of heat passes off into the atmosphere. When the checker-bricks have been heated to a temperature of 1,200 degrees Fahrenheit, the hot air blast is shut off, the apparatus is sealed up tight, and steam is past thru the incandescent coal in the generator, which decomposes into a mixture of carbon monoxide and hydrogen, called water gas. After the latter has been past into the carburetor, oil is sprayed into the enriching chamber, which oil becomes gasified or converted into hydrocarbon gases. The mixed gases after passing thru the checker-bricks in the carburetor, go thru the superheater, and the gas fixt by the superheating, having been washed, scrubbed, and purified, is past into the holder ready for the consumer.

After a production of about 3,750 cubic feet of gas, a period of 8 to 15 minutes duration, the temperature of the checker-bricks becomes too low for efficiency, so that they again have to be heated to the required incandescence, this taking from 4 to 10 minutes. So the operation continues, 8 to 15 minutes runs of gas, followed by 4 to 10 minute delays in producing the water-gas and in heating the checker-bricks. In 8 hours from 16 to 32 runs are made, with a production of approximately 60,000 cubic feet of gas, at a cost of about $66.00, or $1.10 for every 1,000 cubic feet of gas produced, as based on plants operating near New York City.

In the contact of the steam with the incandescent coal, and of the oil with the heated checker-bricks, a considerable portion of these constituents is destructively decomposed into lamp black, and tar, thus entailing waste, while the introduction of air during the process contaminates the gas with nitrogen and carbon dioxid, which possess neither heating nor illuminating value.

By substituting electric incandescent

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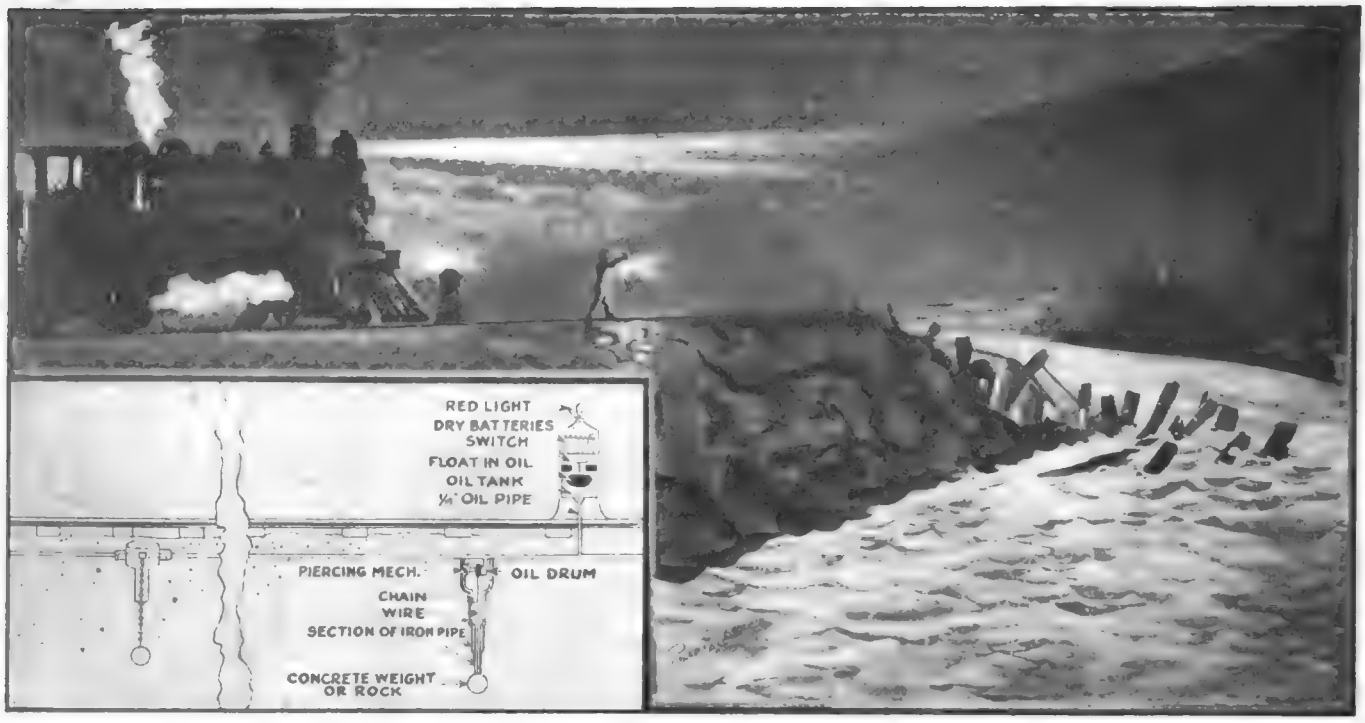
A Washout Signal for Railroads

By H. N. KIRK



Washouts on Railroads, Particularly in the Western Part of This Country Where Many Rivers Rise to a Dangerous Height Several Times a Year, Occupy the News Columns of Our Daily Papers Quite Frequently. Here Is a Newly Proposed "Washout Signal" for Railroads Which Operates as Follows:—The Electric Signal Lamp or Lamps, Placed at Some Distance from the River, Is Connected with an Oil Chamber and a Series of Piercing Mechanisms, Which in the Event of a Wash-Out are Disrupted by the Weight Shown Being Washed Loose, Allowing the Oil to Escape from the Float Switch Chamber and Causing the Signal Lamp to Flash.

THIS appliance consists of two iron posts that are placed at any point that is considered to be in danger of possible washouts. The posts are on small concrete foundations at the side of the track at a distance from the danger point sufficient to allow the use of the brakes in time to stop the train before the washout is reached. The object of having two posts is to give warning in both directions.

The posts are hollow and have at their top a red light which is run by dry batteries contained in the posts. Below the batteries is a switch that is operated by a float member that floats in a small oil tank within the post. At the bottom of the tank is a small lead pipe that runs along beside the track about one foot below the surface of the ground. This pipe connects both posts and their tanks. Along its line it has piercing chambers on the upright sectional pipes that are hollow and contain a wire that is connected to a lever in the piercing chamber. This wire is also connected by short brass chains to each section of pipe. Now if the water should undermine the track it would cause these pipe sections to fall and pull the wire that would work the piercing lever, and the oil drum would be punctured and the oil would run out. This would cause the floats to descend in the light-post, and would operate the switch thus the circuit would be completed and the red light would be shown to warn the engine runner of danger.

If the railroad bed was too stony, wire loops of heavy copper wire would be looped directly around the pipe and the other end would be attached to rocks in the bed. If water should undermine the rocks, the wire would break the pipe and cause the oil to leak out and the lights would be lighted as above described.

Dehydrating Fruits and Vegetables

We illustrate a domestic dehydrator which is designed to dry fruits, vegetables, and other food products, so that they will last indefinitely, will not lose their fresh flavor, and can be restored to their original conditions by soaking in water. The preservation of food by drying is a very ancient art, and during the World War a good deal was said about it, and it was rather extensively applied. The belief is that our housewives fail to adequately realize the value of dehydration for preparing vegetables for use in the winter months, and the inevitable waste of fresh vegetables can be effectively combated by the dehydration process.

"Domestic Dehydrator," Which—Its Inventor and Authorities Who Have Tested It Declare—Dries Fruits, Vegetables, Etc., so That They Retain Their Fresh Flavor, and When Soaked in Water Will Regain Their Original Size and Color. The "Secret" of the New Dehydrator Is Said to be Its Slowness of Operation. Not a Thing but Water Is Removed from the Food, It Is Claimed. Hence the Addition of Water to the Dehydrated Food—Which Keeps in Any Climate—Means Virtually Fresh Fruit or Vegetables.

The supposed secret of the new dehydrator which we show in our illustration is said to be its slowness of operation. It is claimed that nothing but water is removed.

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An Amphibious Gun Tractor

OUR illustration shows an amphibious gun mount tractor which has just been completed and can travel under water to a depth of 7 to 8 feet, just as well as it can on dry land. Of course, the seat of the driver must be arranged so that he keeps his head above the water. This under-water tractor has been perfected by the simple expedient of adding additional sections to the *periscope*, which carries air into the carburetor. The tractor hauls a three inch field gun and brings it to terra firma ready for action. One photo shows the tractor going backward at the rate of 10 miles per hour in a stream of muddy water where the bottom could not possibly be seen. The second photo illustrates a demonstration of the tractor with a three inch field gun mounted, before a U. S. artillery officer.

Here is the Amphibious Gun Mount Tractor. This Tractor, Just Completed, Can Travel Under Water to the Depth of 7 to 8 Feet Just as Well as it Can Travel on Dry Land. Of Course, the Seat of the Driver Must be so Arranged When the Machine is Traveling Under Water, That He be Above Water. This Under Water Tractor Has Been Perfected by the Simple Expedient of Adding Additional Sections to the "Periscope," Which Carries Air Into the Carburetor. The Tractor Hauls a Three-Inch Field Piece and is Ready for Action.

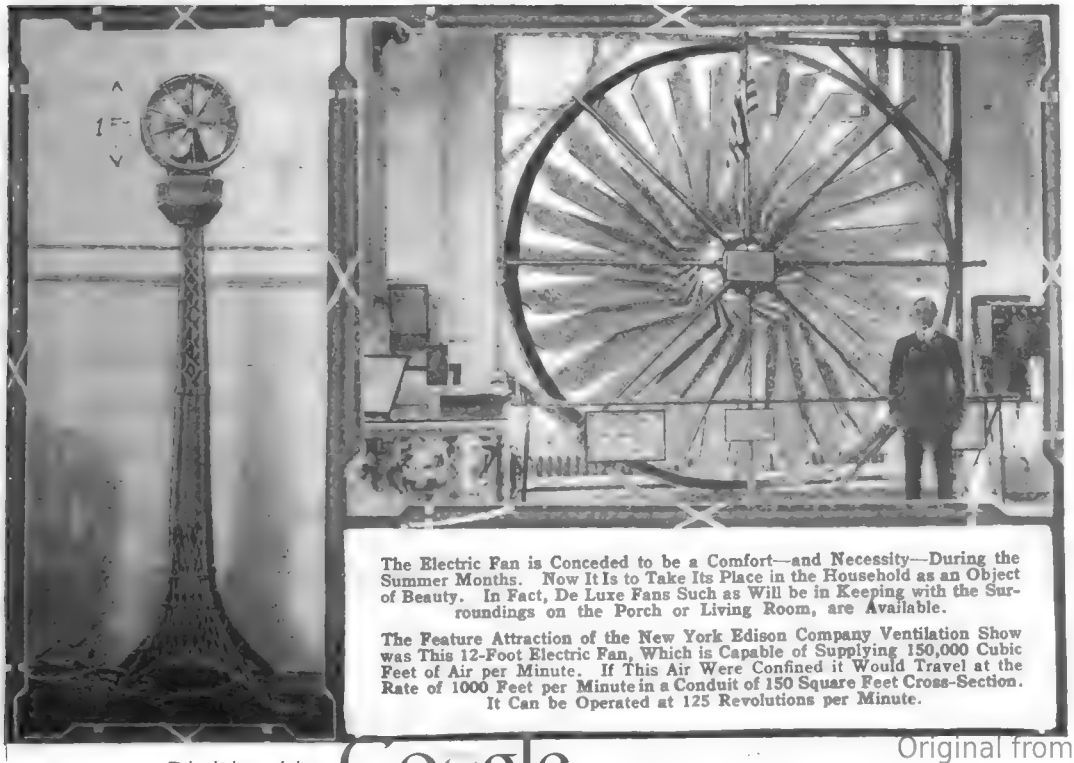
One Photo Shows Tractor Going Backward at the Rate of 10 Miles per Hour in a Stream of Muddy Water Where the Bottom Could Not Possibly be Seen. The Second Photo Illustrates Demonstration of the Tractor With Three-Inch Field Gun Mounted, Before a U. S. Artillery Officer.

The World War demonstrated to military experts that such a tractor as the one here illustrated is almost imperative, where open warfare is to be carried on, even tho there are not many rivers to be forded, for when heavy rains inundate the terrain, many small streams and rivulets are formed. Under such conditions hundreds of what were impassable roads confronted the officers in charge of the Allied Armies and the realization of the capabilities of the amphibious gun tractor will cause it to meet with ever increasing favor.

It may sound somewhat extravagant or superfluous to suggest that such a tractor be developed a step further, and designed with a suitable housing for the driver so that it could navigate under water, but such a design might prove very valuable for attacking across bodies of water such as the river Meuse, which was charged time and again under fire with a terrific loss of lives of American troops. This river like many another was raked with German machine-gun and artillery fire. If armored under-water tractors had been available, troops could have been taken across the river under water and hundreds of lives saved, for when the Yankees reached the enemy side of a river, the Boches rapidly surrendered their machine-gun and rifle pits without further loss of blood. Over 2,500 men laid down their lives along the bank of the Meuse in repeated attacks during a three day attempt to cross the river, and in the first successful charge at the end of the third day but forty men survived the crossing as the detachment swam the Meuse, carrying no rifles but only automatic pistols. Many of the men were either shot after jumping into the water or else succumbed to the exposure and to their inability to swim. If such tractors as these, capable of traveling under water had been available, this great sacrifice of human lives would have been obviated or greatly reduced.

We mean, of course, large size under-water tractors having a compartment, something on the order of the larger tanks used in the World War, which would hold possibly a dozen soldiers or more. In this way troops could be carried under instead of over a river in making a direct assault on an enemy strongly entrenched on a river bank. Such an amphibious machine could be arranged to rise to the surface when necessary by means of buoyancy chambers.

Giant and Pigmy Electric Fans



The Electric Fan is Conceded to be a Comfort—and Necessity—During the Summer Months. Now It Is to Take Its Place in the Household as an Object of Beauty. In Fact, De Luxe Fans Such as Will be in Keeping with the Surroundings on the Porch or Living Room, are Available.

The Feature Attraction of the New York Edison Company Ventilation Show was This 12-Foot Electric Fan, Which is Capable of Supplying 150,000 Cubic Feet of Air per Minute. If This Air Were Confined it Would Travel at the Rate of 1000 Feet per Minute in a Conduit of 150 Square Feet Cross-Section. It Can be Operated at 125 Revolutions per Minute.

THERE is no question but that the electric fan has got into such universal use, that it has ceased to be regarded only as a luxury and comfort and has now mounted to the status of a necessity. So at last the manufacturers have awakened to the idea of making this necessary comfort-producing article an object of beauty as well as of luxury. The New York Edison Company recently placed on display some new models of household fans, which certainly indicate a great advance in the line of appearance over the none too beautiful articles to which we have been accustomed in the past.

And now leaving the small fans adopted for office and parlor use, we come to one, which, instead of being ten or twelve inches across, has no less a diameter than twelve feet. When this is rotated, it produces a blast of 150,000 cu. ft. per minute. In a conduit of 150 square feet cross-section, the air would flow at the rate of a mile in five minutes.

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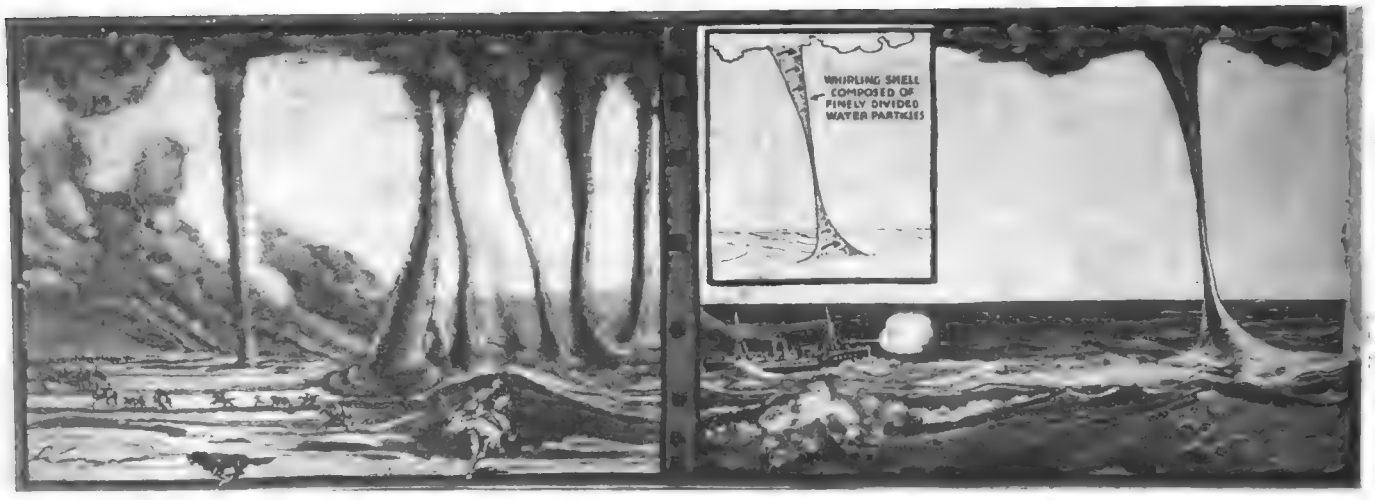
What are Sand and Water Spouts?



Those Who Have Traveled Over the Great African Deserts have Written Their Experiences with the Rapidly Moving "Sand Columns." These are Whirling Shell-Like Columns of Sand Resulting from Cyclonic Wind-Storms.

"Water Spouts" are Caused by the Whirling Column of Air Accompanying a Moving Cyclone Across the Water. The Water Spout Is Composed of a Thin, Whirling Shell of Water Particles; Sailors Used to Shoot at Them with Cannons to Break Them Up.

ONLY its well-established name requires that the waterspout shall be specifically mentioned, since mechanically it does not differ essentially from the tornado. In fact, a tornado becomes a waterspout as soon as it passes to sea, while a waterspout becomes a tornado immediately it invades the land. So says Prof. Humphreys in his "Physics of the Air."

The waterspout, like the tornado, originates well up in the atmosphere, and is especially frequent in those regions where adjacent winds, usually the one above the other, have different directions; hence, where the counter-trade winds, overrunning the trade winds, occur at ordinary cloud or convection levels; along the belt of doldrums, when considerably removed from the equator and flanked by opposing trade winds; and along boundaries of sharp temperature contrasts, such as the northern border of the Gulf Stream. In all such regions vertical convection may induce a more or less violent whirl in the same manner as that causing the tornado.

Occasionally small whirlwinds start from the surface of lakes or other bodies of water during calm, hot weather. The strongest of these produce cloud columns, due to expansion, which are often called "waterspouts," tho of radically different origin from that of the waterspout above described.

Water spouts used to be thought quite solid in their make-up; and it was believed that a well-directed cannon shot would sever one of these spouts, and remove the awesome menace. But the water spout, like the sand column, is composed of a hollow whirling wall of water particles, and is not a solid column of water. Thus the cannon shot would be of no avail.

SAND COLUMNS OF AFRICA

One of the little known phenomena of nature which travelers who have crost the great sand deserts of Africa, may have

(*Continued on page* 654)

Three New Science Wrinkles

In the accompanying left-hand illustration we see Herr Karamel of Berlin steering his amphibious autoboat, the *Autogen*, his own invention. The rear wheels of the vehicle are fitted with small paddle wheels, placed between the road wheels and the hull and covered by the wide mudguards to prevent splashing of the occupant. The single front wheel, having disc sides, resists side motion through the water and is an effective rudder. A nautical touch is given by the marine steering wheel.

NON-REWINDING FILM REEL.

This photograph represents a new invention which takes the place of the lower magazine of a motion picture machine adding a feature which does away with the second winding of the film. This, however, does not involve discarding the present construction, but embodies with it the combination of a reversing reel and means for holding standard reels also.

The basic principle of the invention is a rotary contracting drum which winds the film from the outside and finishes in the center, by means of ten fingers which travel with the drum and hold the film outward. As the film builds up the fingers yield inwardly and at the point where the film enters, these fingers are lifted and lowered again by positive cam action, without a spring. With this new device the film is taken from the picture machine

(*Continued on page* 654)

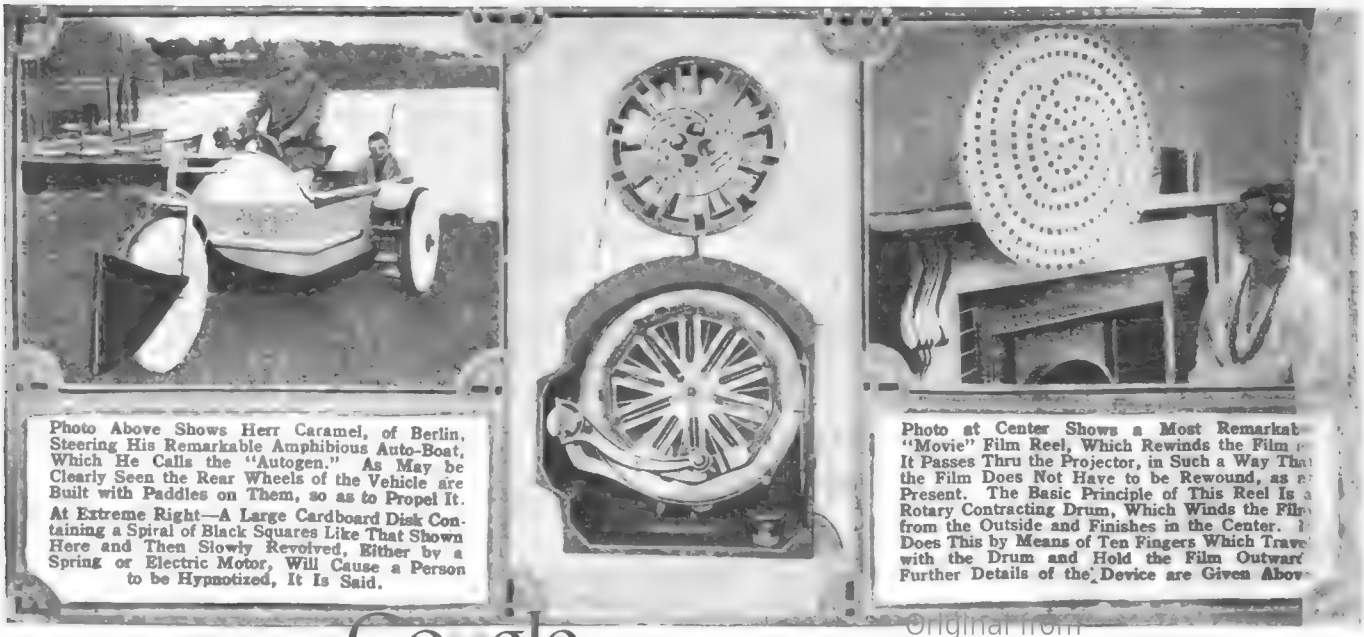


Photo Above Shows Herr Caramel, of Berlin, Steering His Remarkable Amphibious Auto-Boat, Which He Calls the "Autogen." As May be Clearly Seen the Rear Wheels of the Vehicle are Built with Paddles on Them, so as to Propel It.

At Extreme Right—A Large Cardboard Disk Containing a Spiral of Black Squares Like That Shown Here and Then Slowly Revolved, Either by a Spring or Electric Motor, Will Cause a Person to be Hypnotized, It Is Said.

Photo at Center Shows a Most Remarkable "Movie" Film Reel, Which Rewinds the Film as It Passes Thru the Projector, in Such a Way That the Film Does Not Have to be Rewound, as at Present. The Basic Principle of This Reel Is a Rotary Contracting Drum, Which Winds the Film from the Outside and Finishes in the Center. It Does This by Means of Ten Fingers Which Travel with the Drum and Hold the Film Outward. Further Details of the Device are Given Above.

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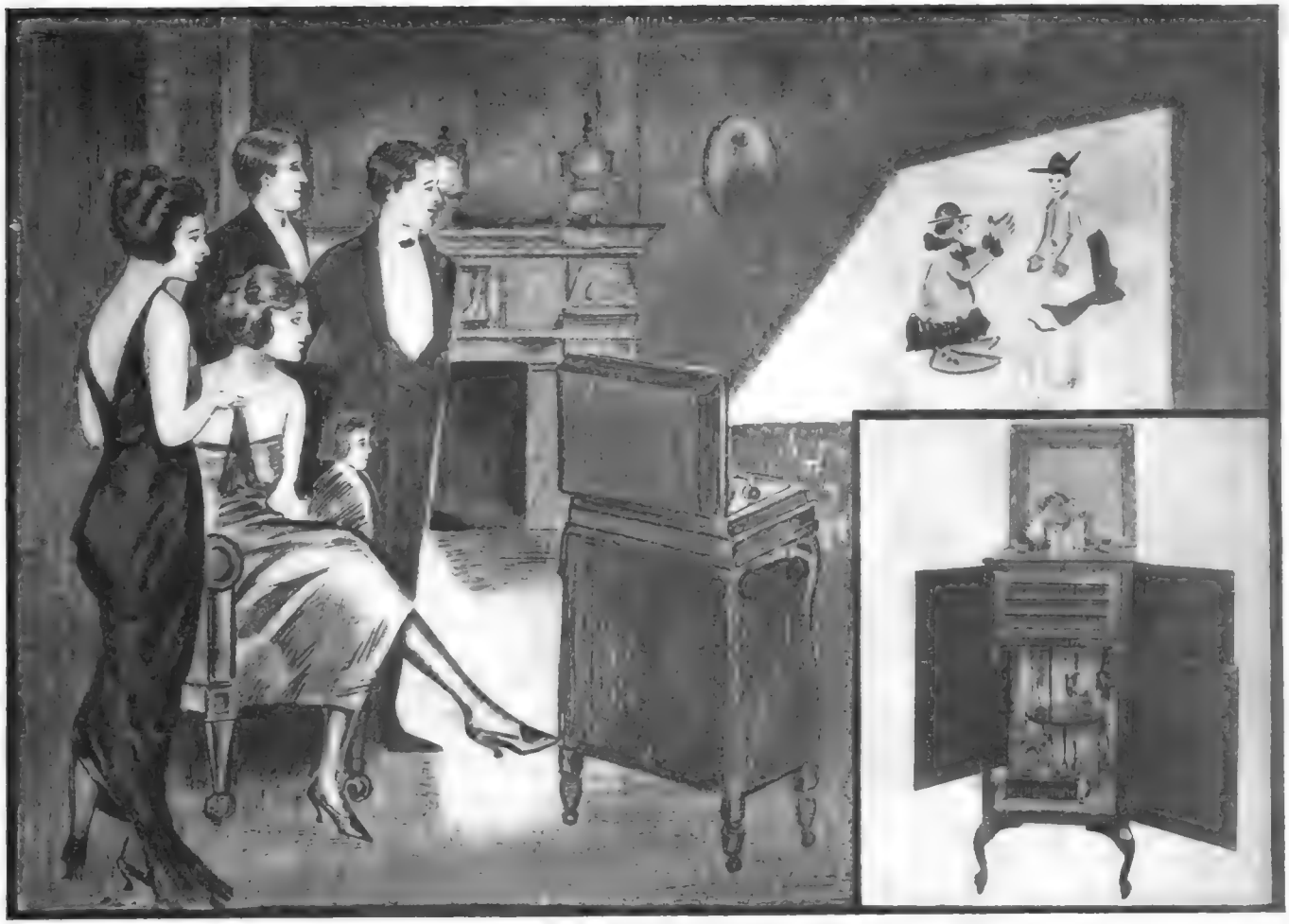
A Home "Movie" Phonograph



The Phonograph Has Become a Permanent Fixture in Our Home-Life Everywhere Today, but Recently There Has Been a Great Deal of Interest Manifested in a Machine Which Would Not Only Provide Us with Pleasant Musical and Vocal Selections, but Which Would also Produce Motion Pictures with the Music. The Insert Photograph at the Right Shows a New English Machine Which Does This Very Thing, and Moreover It Operates Synchronously, the "Movie" Images Being Projected on the Screen in Exact Step at All Times with the Music Given Forth Thru the Sound Chamber. As Will be Seen the Turntable Supporting the Disk Record Is in the Lower Compartment, While the Collapsible Projector Is Mounted on the Top of the Cabinet.

ONE of the earliest ideas in connection with the phonograph was to synchronize it with moving pictures, so that there should be presented a complete play to the public. If the synchronism is defective the results are disastrous. The actor's mouth will be seen open when no sound issues from it, and when the lips close the sound may be at its loudest. We present to our readers an illustration of a new English parlor apparatus designed for this purpose.

On the upper stage is a projection machine and the film is there seen with one end threaded into the projector. Below in the base of the cabinet is the phonograph proper. The reproducer is seen below and from it the sound-horn rises into the sound amplifying chamber with its louvered opening. Installed in the body of the machine is an electric motor with control rheostat to drive the phonograph and the projector. In a small apparatus of this type, the illumination given by a Mazda lamp is all sufficient, so that the annoyance of an arc lamp with its rheostat and carbons is not present.

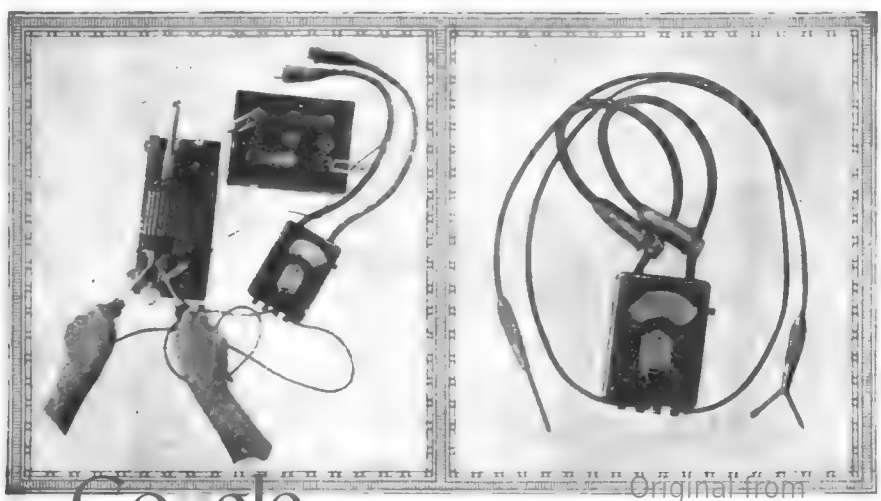
The illustrations tell the story. The general lay-out of the machinery is very clearly shown and in one of the cuts the personal element enters, where we see the family audience looking and listening.

Electric Trouble Detector for Autoists

The instrument combines five instruments in one. It is so designed that a series of simple tests, readily made and requiring no special electrical training, will enable anyone with this instrument to discover the cause of any defect or failure in the generator, starting motor, lights, horn, switches, wiring, battery or ignition apparatus.

With the detector is furnisht a complete and easily understood instruction book. This book is an excellent textbook for wiring, electrical troubles, etc.

The testing apparatus is a combined voltmeter and ammeter, with 3 voltage and 2 ampere scales for accurately testing any electrical pressure or current found in automobile equipment. The makers furnish leads, props, clips, and a Cadmium test electrode. There are no external shunts.



The instrument combines a voltmeter reading from zero to 30 volts for testing the generator, lights, horn, etc., a voltmeter reading to 3 volts for battery cell tests; a voltmeter reading to 3/10 volts for testing armature and field coils; an ammeter which will measure current up to 300 amperes for testing the starting current; and an ammeter for current from zero to 30 amperes for generator and other low current tests.

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Movie Star Sees Electric Potato Peeler

The Details of This Electric Potato Peeling Machine on the SS "Yale" are Being Explained to Miss Marjorie Daw, Movie Star

Motion picture stars have something else to do besides looking pretty when the director yells "Go." Here we see Miss Marjorie Daw, famous movie star, being shown the wonders of the electric potato-peeling machine in the kitchen of the steamship "Yale." The details of the machine which are simple, are being explained to the fair Marjorie by Mr. A. L. Levy.

It is an interesting fact that practically all of the modern hotels as well as ships, even the smaller establishments, perform most of their kitchen work by means of electrically-operated machines. Chief among the kitchen details accomplisht in this way is the peeling of potatoes. There is usually but one thing left to do after the machine has peeled the potatoes—several bushel of them or more, depending upon the size of the machine—and that is for an attendant to cut the eyes or spots out of the potatoes, which is accomplisht usually by pushing the potato against the revolving cutter.

Scientists tells us that if we want to realize the real benefit from eating potatoes, we should not peel them, but should cook them with their jackets on: so as to preserve the highly desirable vitamines, which reside just under the skin.

This Machine Detects Liars

A Mechanical Solomon—A Combination of Machines Which Will Detect Prevarication in Man or Woman.

William Moulton Marston, a Boston lawyer and scientist, is shown here with his scientific *Lie Detector*. Three complicated pieces of machinery are used to detect deception in a witness or other subject.

First—The Chronoscope. It measures in hundredths of a second, the time the witness takes to answer questions—*innocent* questions and questions connected with the case under consideration are verbally *shot* at him. He can't lie without hesitating a fraction of a second—and the chronoscope measures and records the delay with deadly accuracy.

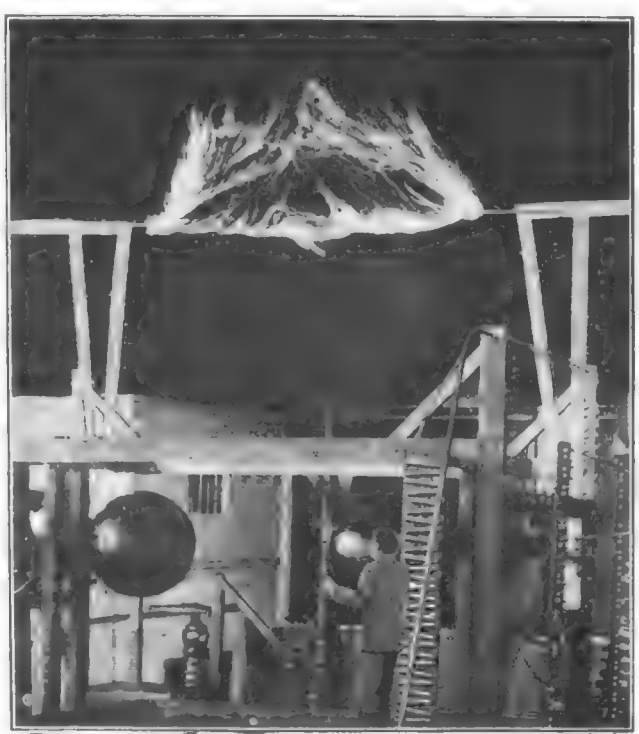
Second—The Kimeograph. This measures the respiration of the suspect as he answers questions and records it in traced graphs or curves on a smoked cylinder. And a man breathes differently when lying.

Third—The Sphygmometer. This charts the blood pressure during the questioning. When a man is lying his systolic blood pressure rises rapidly in a *flying curve*.

Scientists say that if a subject reacts *guilty* to all three tests his deception or attempts at deception are practically proved in the full scientific meaning of the word proof.

One Million Volt

Recent spectacular experiments at the Pittsfield, Mass., experimental station of the General Electric Company, were made in the production of one-million volt potentials. Each stepping up of the potential was watched and followed, and eventually as the final million volts potential difference was reached, tremendous discharges were obtained, one of 15 ft. is illustrated in our cut, and the foundation at least was laid for the development of the economical transmission of power over great distances. It was ascertained that the ex-



Power Transmissic

ternal diameter of 1,000,0[illegible] transmission line wires [illegible] have to be as large as 4 in[illegible] A steel core conductor [illegible] proper wires wound arou[illegible] outside was also among [illegible] possibilities tried out su[illegible] fully. The large diameter [illegible] ductors were found nece[illegible] to reduce the corona or [illegible] loss to a practicable value. [illegible] rents at such potentials al[illegible] tend to leak off small or po[illegible] conductors excessively; [illegible] large 4 inch conductors pr[illegible] a more easily rounded sur[illegible] thus minimizing such leak[illegible] which of course is a direct [illegible] of electrical energy.

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Animals That Have "Rubber Heels"

By Dr. ERNEST BADE

THE air cushion of which we hear so much in all kinds of mechanical devices and instruments, not to mention the cushion in our rubber heels, is by no means a new or an original invention. Many insects have them, and especially the grasshopper, which was in existence during the carboniferous period when coal was formed.

All softer parts of an insect are enclosed in a more or less hardened chitinous covering, which is commonly called the outer skeleton. Within this skeleton all muscles and meaty parts are formed and, when the grasshopper lands after jumping, it would receive a slight jar, if no means of absorbing it were provided. Of course the joints take care of part of the shock, and the few bristle-like hairs found on the extremity also do this. But even these are insufficient to absorb the entire jar. Therefore Nature went to work and evolved an air cushion.

This air cushion is situated at the extreme tip of the tarsus and just beyond the two claws of each foot. The claws help to keep the insect in precarious position where, without them, it would inevitably slip. By their means it can find lodgement on smooth grasses.

The air cushion of the grasshopper is a round ball filled with air and also provided with a few hairs. These in a large measure, absorb the shock when the insect lands on some rock or boulder. Of course, when it lands on some herb or grass, the shock is absorbed by the swaying plant. Other insects have their legs adapted for special purposes, and these are dependent on the mode of life of each individual.

The Upper Photograph Shows the Jumping Leg of the Grasshopper With Its Small Air Cushion at the Extreme Right or at the Tip of the Tarsus, and Just Beyond the Two Claws of Each Foot. These Claws Help to Hold the Insect in Precarious Positions. The Lower Cut Shows the Air Cushion Magnified.

The Production of Colored Cotton

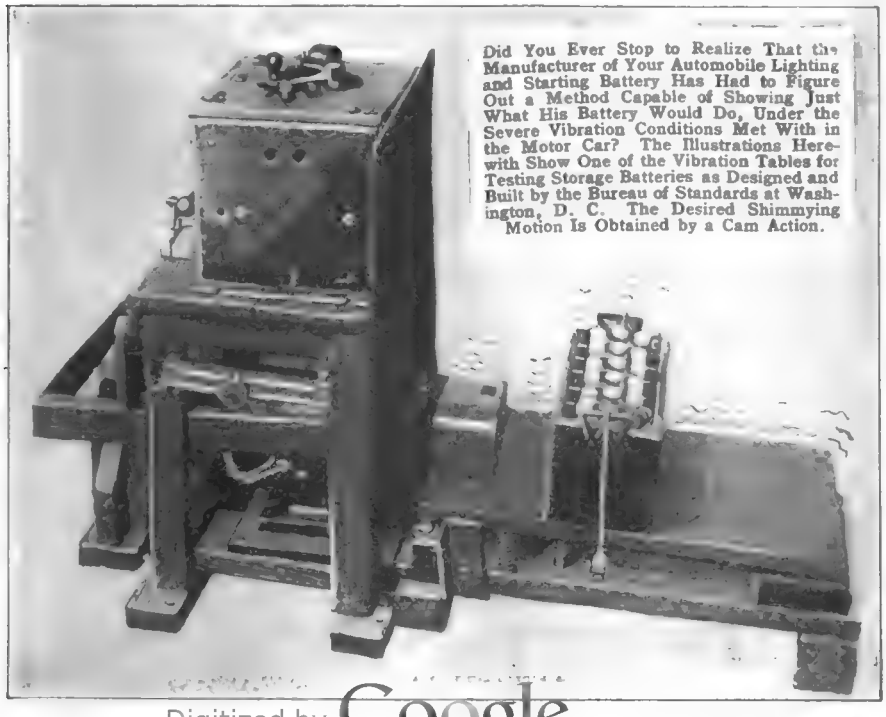
A. W. Brabham has submitted to the Cotton Exchange of Savannah, Ga., four samples of colored cotton—light brown, dark brown, light green and dark green. They are the results of years of experimentation. Mr. Brabham says that other colors will appear when a number of cotton plants in his garden, that are not yet fully grown, begin to bear.

The botanist has not yet been able to produce black cotton, but he says he will do so in time. It would have appeared this year, he contends, if a package of the seeds of a blue-tinted cotton mailed to him by a botanist in Delhi, India, had not gone astray. Mr. Brabham has sent for another package of these seeds, and he is convinced that if he crosses them with certain of the cottons he has already grown the result will be black.

Luther Burbank once told Mr. Brabham that he would produce black cotton for a million dollars. Mr. Brabham replied that he thought he could do it more cheaply, and thereupon started his experiments.

"Shimmy" Board for Testing Batteries

A vibration board, which operates with a "shimmying" effect, has been designed and built by the Investigation and Testing of Electric Batteries Section of the *National Bureau of Standards* for the testing of storage batteries. This testing equipment differs from previous designs, in that the batteries are jolted by the movement of springs, thereby more nearly duplicating the conditions with which they are surrounded in actual practise. The influence of jarring on the life of the battery, as well as the relative durability of different types, will be revealed by this newly-constructed apparatus.



Did You Ever Stop to Realize That the Manufacturer of Your Automobile Lighting and Starting Battery Has Had to Figure Out a Method Capable of Showing Just What His Battery Would Do, Under the Severe Vibration Conditions Met With in the Motor Car? The Illustrations Herewith Show One of the Vibration Tables for Testing Storage Batteries as Designed and Built by the Bureau of Standards at Washington, D. C. The Desired Shimmying Motion Is Obtained by a Cam Action.

The "shimmying" motion is obtained by a simple eccentric or cam action, the eccentric being keyed to the shaft of a motor and transmitting the movements downward against spring tension. The springs are visible in the illustration, and the battery is seen in place on the board subject to vibration. The motor is quartered under the controller box, which is on a platform. A field rheostat, on a rack, regulates the speed of the motor, its range of frequency being from 300 to 1,200 r.p.m. A tachometer is seen at the extreme left of the photograph, while the cam which operates the vibration board is under cover, located between the battery and motor.

Similar apparatus, previously built for studying the behavior of storage batteries, when used on automobiles, were operated in the absence of coil springs. This omission made difficult the duplication in the laboratory of the actual conditions to which batteries were subjected on automobiles. The "shimmying" effect should yield information on defective lead burning, and should indicate the slopping of acid or electrolyte around the terminal point. The life of a storage battery in use may vary from a few months to four years or longer.

This is not the only application of a shimmy board as electrical and other manufacturers have used a similar arrangement for testing various other devices and instruments. Telephone manufacturing concerns have used a similar vibrating table for carrying out a test of twenty-four hours or more on microphones, for example. Other manufacturers have used this vibration test for determining the reliability of electric measuring instruments.

Contributed by S. R. WINTERS.

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Machine Reads Your Character

Here We Have the Newest Character Reading Machine—the Plastometer—Recently Perfected by Professor Burger of Berlin. With This Apparatus It Is Possible to Quickly Measure All the Facial and Cranial Protuberances. Whether or Not You Believe in Reading Character, This Instrument Will Provide All of the Data Needed in Diagnosing Subjects by the "Bumpologist."

THE accompanying photographs show a machine, which, we take it, is the very latest invention for reading your moral character by exact measurement; that is if you believe in phrenology, or reading character by the shape and size of the head and as well as by the degree and location of the various bumps and valleys of the cranium.

The name of this new character reading machine is the *Plastometer* and it was perfected by Prof. Burger of Berlin. Prof. Burger claims to read your moral character by the millimeter. He says that with the aid of his instrument one can, in one hour, look into the life of the soul and body, which otherwise would take months of keen observation. He also claims that his apparatus will aid the authorities in determining the moral character of criminals.

One of the photographs shows Dr. Burger measuring the moral character points of a young lady patient, while the second photo gives a closer view of the lady's head with the instrument in place. All of the adjustable rods and correlated parts of the instrument are finely calibrated, so that the position of any of the measuring rods can be instantly read off on the scales. By checking up the measurements obtained from a patient's head, with those obtained from thousands of other people, and by carefully studying the characteristics resulting from a given size and shape of head, the subject's mind can be judged, it is claimed, quite accurately. In other words, there is nothing mystical about the instrument or its use, any more than there is in modern palmistry. You have your hand read by a Gypsy palmist and because her clothes are bizarre and her manner mysterious, you think quite possibly that she possesses some special God-given faculty for telling you your personal life and details of the past, present or future, by looking at the lines in your hand. There is no such thing, so far as the "mystery" is concerned, and all that the palmist can do or ever has done, is to make a special study of thousands of hands and then, by utilizing the mathematician's well known *law of averages*, he or she learns to judge almost instantly the mental traits of the subject before them. The accuracy of palm reading is claimed to be about 72 per cent., and the same percentage may be taken as approximating the accuracy of the results obtained with the machine devised by Prof. Burger for judging character by measuring the size and contour of the head.

Mailing Machine Eliminates Stamps

A machine for stamping envelopes, carrying out a process to take the place of the manual application of postal stamps, is illustrated here. No postage stamps are used. The machine at the rate of 250 envelopes per minute stamps the letters with a printed mark. The Post Office authorities set the machine, lock and double seal it. It is then ready for use. The envelopes are put thru and the counter of the machine determines how much postage is to be paid. It prints on each envelope the name of the office, and the time of mailing, exactly as in the present stamp cancelling machine. The imprint which it puts upon the envelope is of the size and shape of the regular Post Office cancelling stamp, and is to be a legal substitute for the postage stamp. It contains the inscription, "U. S. Postage Paid 2c." To purchase postage the lessee of the machine carries a meter like apparatus to the Post Office, where an employee sets it for the amount of postage required, payment being made in advance. The meter has a range large enough for 100,000 stamps less one.

Business houses will welcome with open arms this postal stamping machine for one of the greatest nuisances and time wasters in office and mail order work has always been the item of postage stamps. It is, moreover, a dirty, messy job having to moisten several thousand stamps and place them all on envelopes, one by one. If nothing else the job of pasting the stamps on the envelopes would be called an entire waste of time and labor by any student of efficiency engineering, as it is being applied to our modern office and factory systems everywhere to-day.

The Illustration Above Shows a Machine Recently Perfected and Which Is to be Adopted by Large Business Concerns for Stamping Mail Without Having to Bother with the Separate Postage Stamps Ordinarily Used. This Machine Stamps the Official Postal Frank or Seal on Envelopes at the Rate of 250 Per Minute. A Counter on the Machine Determines How Much Postage Is Due to the Post Office.

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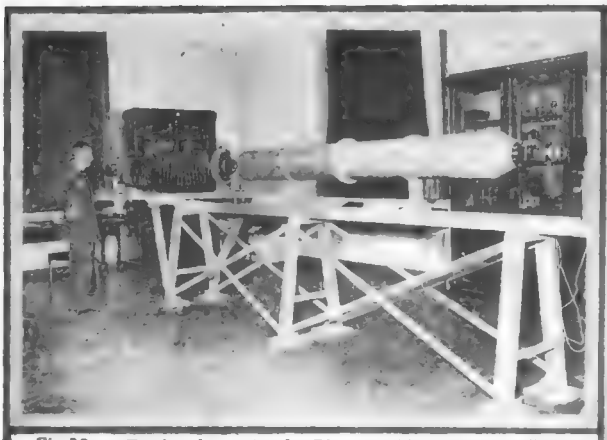
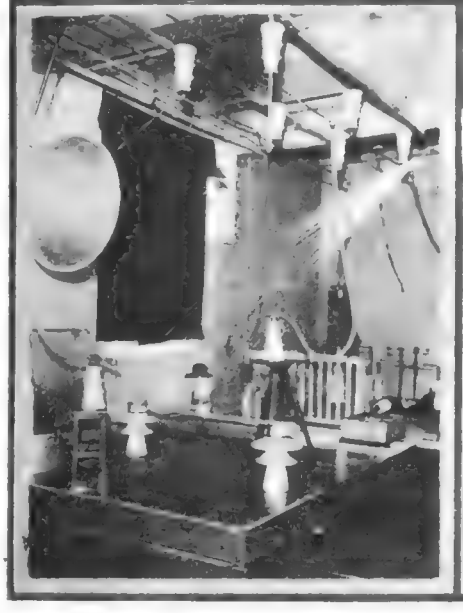
The Royal Physico-Technical Institute at Berlin

WE present herewith several illustrations of the apparatus in the Royal Institute in Berlin, which is a sort of Bureau of Standards, and in which the most extensive ground is covered in trying out different electrical devices and measuring the efficiency of various machines and appliances. The first illustration shows an apparatus for testing telescopic, and more especially photographic objectives. The apparatus is due to the great optical firm of C. P. Goerz in Friedenau. The photographic objectives to be tested are screwed into the front board of the camera seen on the left hand of the cut. The table carrying the camera can be swung around the perpendicular axis passing thru the center of the objective. The large tube is about nine inches in diameter and over 18 feet long. This is used for testing long focus objectives. Another division is shown in one of the cuts; it contains extensive apparatus for photometering street lamps. A vertical beam is arranged with a bracket, so that the lamp can be placed at any desired height up to 30 feet. The balconies, which are seen at the right and back of the cut, are reached by circular stairways, and are used for manipulating the lamp at different altitudes. In another department high tension insulators are tested and one of the cuts shows an insulator carrying bare conductors subjected to a spray representing a heavy rain storm, while the last cut shows a cataract of sparks produced by a 175,000 volt potential.

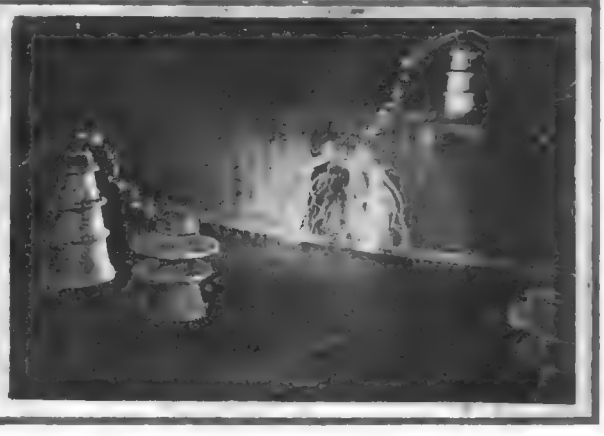


Six-Meter Testing Apparatus for Photographic Objectives Which are Screwed Into the Camera on the Left. The Large Collimeter with Objective of 22 Centimeters in Diameter has a Focal Length Corresponding to the Length of the Tube of Three Meters.

Measuring the Candle-Power of Lamps to be Used at High Elevations. The Lamp to be Tested can be Placed at any Desired Height by the Arrangement Clearly Shown in the Cut.

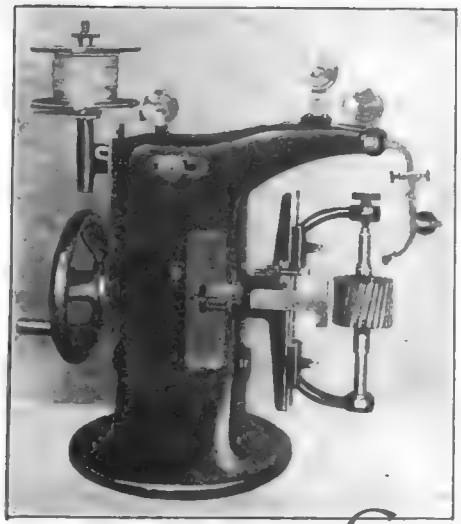


Test of a High Tension Insulator for Bare Conductors Under Artificially Produced Heavy Rain.



Formation of Sparks in the Testing of an Insulator at a Tension of 175,000 Volts. This Test Always Presents a Spectacular Sight.

Armature Winding by Machine



This Armature Winding Machine Which May be Manually or Motor-Driven, Is Claimed to do the Work of Four Armature Winders, and It Will Moreover Wind any Type or Size of Armature Up to One Horse-Power, Without Removing the Commutator. It Counts the Turns and Twists the Leads Automatically.

The makers of a new armature winding machine claim for it that it will do the work of four men at the expense of one man's time. It winds any type or size of armature up to 1 horse power, without removing the commutator. It weighs only 65 pounds and may be driven by hand or power. It is especially designed for repair shops and small manufacturers. It winds with uniform tension, counts the turns, and makes and twists the leads. It is said that a one horse-power armature may be wound in twenty minutes on this machine.

Those who have ever had any experience in winding motor or dynamo armatures will appreciate what an advantage and time saver a machine of this type really is. It is very difficult or at least it has been, to endeavor to wind armatures automatically by machine, owing to the very small space into which the wire has to be wound for each coil, and particularly on account of the fact that the end turns of each coil have to be overlapt or wound one over the other. From this it may be seen, and experiments invariably showed, that owing to this intricate arrangement, the wires would tend to overlap or catch in the wrong slot, not to mention several other difficulties, which showed themselves whenever an automatic machine was devised to wind armatures of the hand-wound type.

Armatures such as used in machines above 1 H. P., which are usually wound with form wound coils, each coil being a separate unit, do not require any machine for their winding, the armature winder slipping the unit coils into the slots, one by one, and hammering them into their respective slots, one after another. But for the hand-wound armatures, which do not employ form-wound unit coils, an armature winding machine is a very necessary and desirable device.

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Editor's Mail Bag

THOSE COVERS.

Editor SCIENCE AND INVENTION:

I would like to make a suggestion in regard to your publication. In making up a front cover I should think it more appropriate and advisable to have a design less fantastic. I realize that probably you expect these monstrous and perhaps slightly inconceivable designs to attract the eye of the public while passing newsstands through the very idea of their magnitude and uncomprehensiveness. You also probably rely upon the merits of the magazine proper to hold the subscription of your steady readers. Yet I would suggest that a more scientific realism be substituted for, or added to the inventive imagination now existing, for even steady readers must be satisfied once in a while. By this I do not mean to say that your cover designs have never been good, for many have been excellent, as for example, your butterfly design. But please make them more common and more numerous in your coming issues, and, if possible, have them bear directly on your biggest feature in that particular issue instead of some unimportant article.

Another suggestion is that you keep to your original field and not branch off into the gilded scientific field which is already occupied quite nicely by several other magazines.

Lastly, I wish to express my sincere liking for your articles on "Popular Astronomy," "Practical Chemical Experiments," and the department known as "The Oracle;" and also my appreciation of your sportsmanlike spirit in publishing the "Editor's Mail Bag," containing such letters as this one.

TEMPLE C. PATTON.

26 Valley Road,
Milton, Mass.

(The year, let us say, is 1821. An intrepid man with a little imagination prints a scientific magazine, called, let us say, "Ye Science for All." On his covers he shows successively the following "dreams": A man soaring in a flying machine. A steel vessel holding a score of men running below the surface of the sea. A man in London talking to a man in Paris thru a thin wire. A carriage running without a horse. A message flashed from shore to a ship in mid-ocean. A 10-car train running below a river bed. A 60-story steel building. A machine that speaks and sings. Pictures that move on a screen. A machine to see thru your flesh and show your bones.

What would the 1821 critics have thought of such crazy "fantastic" covers? The publisher probably would have landed in an insane asylum or worse; and, in less than 100 years all of these fantastic dreams came true.

Some of our covers may look fantastic now. But how our great-grandchildren will smile derisively at our feeble attempts to portray the future! Our imagination is far too poor to even express a fraction of the wonders lying beyond.

—EDITOR.)

TOO FANTASTIC—BUT TRUE.

Editor SCIENCE & INVENTION:

I have read SCIENCE & INVENTION for a number of years and I really think that it has deteriorated a little. It is a very good magazine, however, and I get much benefit out of it.

There is one feature of your magazine, however, that amuses me, but which to others is probably great. You are making many efforts to impress upon your readers the more profound problems of our existence, but the articles you use to do it are too imaginary to be true. I have studied for some time on some of the "life" problems you present, and while I do not wish to appear as a "wise" one, I will say that I think you often overstep the bounds of good solid reason.

A great many things that the ancients taught are slowly being accepted by science as facts, where in the past they have been pooh-poohed at. Still other things taught by the ancients will be accepted. They had some wonderful views and explanations of life. Don't you think that some of them would stand investigation? When science began to be called Science, it looked down on the ancients, and discarded the old theories without investigation, a wholly unscientific procedure. Now investigation of the old ideas is upsetting many of the modern ideas.

So with a great many of your articles, they are looking ahead into the future, disregarding the work of the past. The past is the place to get inspirations for the future. If some of those articles are examined under the light of old knowledge, which is beginning to be accepted as truth, you will find they are but shells of fancy, spectacular, and all that, but lacking a sound reasoning basis.

WE invite our readers to use these columns for discussion on all subjects of interest to them. We aim to make this page an exchange place for ideas and invite discussion. As hundreds of letters are received weekly, it is manifestly impossible to publish all of them, and we aim to publish only the more interesting ones. Try to keep your communication within two hundred words, and use only one side of the paper when writing. It is not possible to answer communications addressed to this department by mail due to the great influx of communications received.

—EDITOR.

Too many of your articles assume the grossly material aspect, as tho the problems of life could be solved by the use of material things. When will man finally realize that there are two things in the world—matter and the not-matter?

Your popular astronomy articles are good, and so are your chemistry articles, your nature articles are good, and articles like your "Airplane or Battleship—Which?" are good.

Your article, "Movies of the Future," is a little too fantastic for a magazine of the standard you have maintained, tho it could be toned down quite a bit, for if you left out the statement about teaching dancing and piano playing, it would be quite reasonable, and it would still be reasonable if you had arranged for dancing to be taught in a better manner.

"Disease Microbes Thrive on Money" is good. The article on the Aurora is good. It is good all the way thru, except for some of those stories, fantastic, and outdoing Arthur Train, and leaving the author of "Twenty Thousand Leagues Under the Sea" buried in shame, which are too unscientific, and too much without reason to be at all palatable. I am more or less gullible, according to my friends, and believe a lot that they can't see, in regard to things modern and things of the future, but some of those stories are so big, that they disgust me with their size.

There! That is enough. I hope you will not be offended with me for taking up so much of your time, but I had to get this load off my chest.

EARL WAYNE SUTTON.

Elyria, O.

(Sorry friend, but it is never safe today to say that a thing is "too fantastic." "Dancing Taught by Movies" is already a fact—it is being exploited commercially and a company announces that it will teach piano and violin playing by movies right in your own house, very shortly!

—EDITOR.)

ONE FEATURE WORTH THE PRICE.

Editor SCIENCE & INVENTION:

I am no recognized authority on the criticism of scientific literature, however, in my personal opinion, as well as several of my friends, SCIENCE & INVENTION magazine is the ideal medium for keeping the layman posted on every-day advancement in the scientific world.

To be sure, there are certain subjects which are of little or no interest to me, but I could not be so narrow as to want only the subjects which interested *me*, published. There is always at least one feature in each issue which is worth the price of the magazine. *More power to you. Keep it up.*

HARRY M. STEED.

1132 Eighth St.,
Portsmouth, O.

"GREATEST EVER PUBLISHED."

Editor SCIENCE & INVENTION:

I am not able to forego this opportunity of expressing a few thoughts in regard to your publication. This is in connection with your published criticisms. SCIENCE & INVENTION is undoubtedly the most up-to-date and wide-awake popular scientific magazine. The articles that you have published in regard to Dr. Tesla, as well as those dealing with astronomy, insects, plants, etc., are to my mind the greatest ever published of their kind. I have watched your wonderful progress with great satisfaction.

E. H. THOMPSON

1120 Woodmont Avenue,
New Kensington, Penna.

NOT TECHNICAL ENOUGH.

Editor SCIENCE & INVENTION:

In reading over your August issue I came across your request for comments on SCIENCE & INVENTION.

I will say it is the best magazine for popular science but why not more technique? I noticed you took your stand, to a similar question, on the ground that an every-day man doesn't want a technical paper. This may be true, but why not take to the "Golden Mean"?

I was very pleased with the article on "Chemical Analysis." I wished that you could have more chemistry in each issue.

JOS. H. PRECOURT,
Sec'y Junior Chemists.

Chartley, Mass.

(SCIENCE & INVENTION, in its field, i. e., SCIENCE AND INVENTION, aims to do what the "Literary Digest" does in everyday matters and literature. We cover all scientific matters, obviously, therefore we can not devote more than a certain amount of space to any one object. Class journals do just that;

(continued on page 658)

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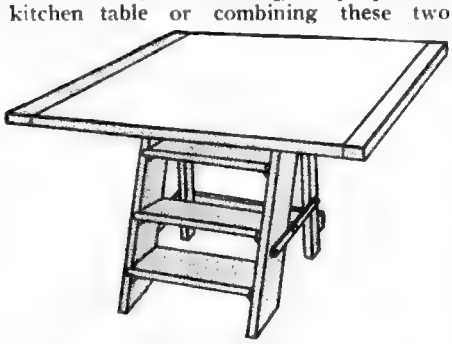
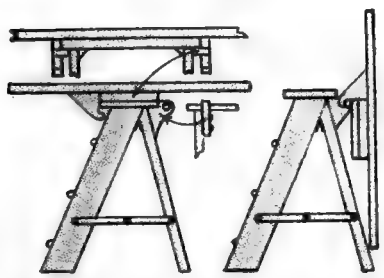
Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

TABLE STEPLADDER

THE illustration shows an ordinary folding stepladder arranged to provide a folding table. The table top can be made of a large sized standard bread-board, thus serving the purpose of kitchen table or combining these two





The Illustration Above Shows a Very Convenient Combination Table and Stepladder, Arranged so That, When the Table is Not Desired, it Can be Slid Forward for a Small Distance and Then Turned Down, as Seen in the Lower Right Hand Corner, so as to Set Against the Wall.

essential features, step-ladder and kitchen table. The ladder is of the ordinary style made table high. The table attachment consists of a bread-board with cleats attached so as to form grooves, that slide over the top edges of the ladder. It is hinged by two grooved blocks, which catch on a piece of ¾" pipe and held by brackets screwed to the back legs of the ladder. The grooved blocks catch on the pipe when the table-top is swung into the vertical position.

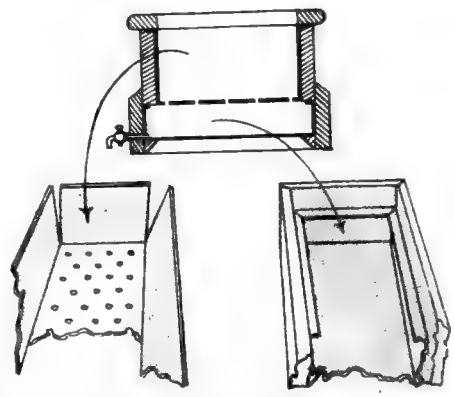
THE MOTORIZED FOOD CHOPPER

The universal electric fan can be made to run the food chopper, without destroying the future usefulness of either the fan or the chopper, by a little ingenuity on the part of the handy-man of the house. In the cut a practical scheme is shown, that can be set up by any home mechanic. A few pieces of board, some tin, screws, 3/16" iron wire and a piece of bicycle chain are the only supplies necessary. Two wheels are made of wood ⅛" thicker than the width of the chain at its widest part. One wheel is to have twelve and the other 24 sprockets, made by cutting the wire into ¾" lengths and driving them into holes bored in the edge of the wheels, as shown. The sprockets should be tapered, altho they will probably work without tapering. The size of the wheels will depend upon the length of the links in the chain—if these are 1" for instance, the wheels will be 12" and 24" in circumference, with the centers of the sprocket holes 1" apart. Disks of tin are screwed on each side of both wheels to form a guide or groove to hold the chain in place and take off lateral strain on the sprockets. A frame with clamps of wood screwed over the base of the fan and to hold the chopper and pan for chopped food completes the device.

INDOOR WINDOW BOX

It is about time to think of bringing the plants in for the winter and to provide ways and means for keeping a few of the choicer varieties where they can be seen and admired. A window ledge is always a desirable location for certain kinds, and to provide the means for keeping them there we have designed a box, shown in the cut, which will not dry out in a steam or furnace heated room. The box consists of two parts, one fitting within the other, both are provided with zinc or copper linings. The top lining holds the plants and is perforated all over the bottom; the lower one catches any surplus water that drains thru the holes in the bottom of the plant box. To prevent an overflow in the lower lining, a small faucet is provided for draining, as shown. It can be seen that this arrangement provides a cellar-like wet tank that cannot very well dry out, one which will furnish moist air to the plant roots in the box above it. This will keep the soil and the roots from drying out in any superheated room.

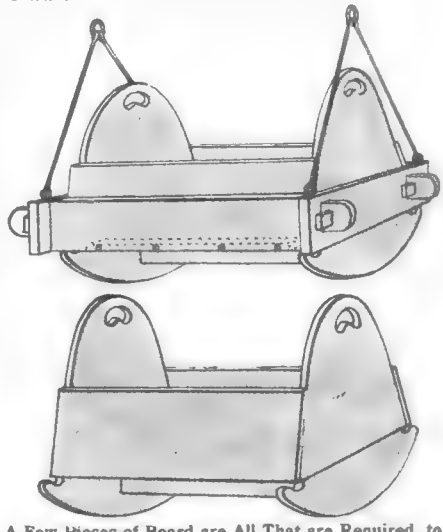
Many of the more pretentious homes today have window boxes for flowers built in to the window frame or ledge and not made separately. Oftentimes this effect can be obtained by a slight amount of carpenter work, and arrangements made for a window seat just below the flower box.



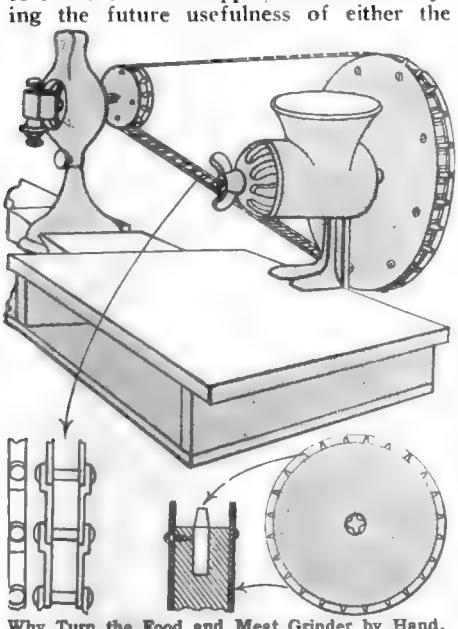
This Indoor Window Box for Flowers is So Designed That It Will Not Dry Out, Even Tho the Room in Which It Is Placed Is Kept Very Warm. The Box is Made in Two Parts, One Fitting Within the Other, Both Being Provided With Zinc or Copper Linings. A Small Spigot Is Fitted to the Outer Compartment for Draining It When Necessary.

DUTCH CRADLE SWING

Fresh air for the baby, summer or winter, can be had, minus all of the inconvenience of tucking him in his swing after going outdoors, by using the combined cradle and swing shown here. The two parts are separable, one occupying a permanent position on the porch attached to two suspension rods, the other being portable; thus it is possible to get baby ready for the outing in the house. More than this, it is possible to rock him to sleep before taking him out, or to bring him in for the night without disturbing him. The cradle is a regular house-cradle made usable out of doors.



A Few Pieces of Board are All That are Required to Build This Attractive Little Cradle Swing. If It Is Made of Chestnut or Oak and Finisht With a Mission Stain or Wax, the Swing Will Present a Real Quaint Appearance. Where the Rest of the Furniture is Finisht in White Enamel, or Some Other Color, the Cradle Swing Can be Painted to Correspond.



Why Turn the Food and Meat Grinder by Hand, When with a Little Ingenuity You Can Rig Up the Fan Motor to Drive It?

IMPORTANT:

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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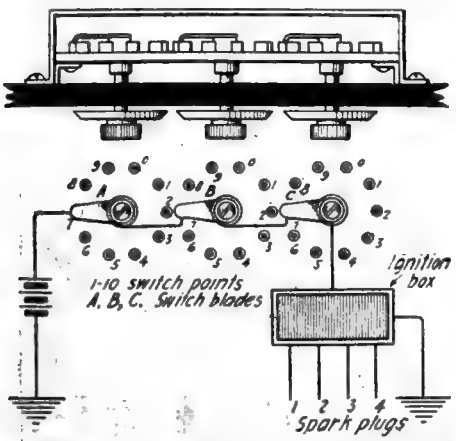
MOTOR HINTS

First Prize, $25.00.

THIEF-PROOF COMBINATION SWITCH.

IN the illustration herewith is shown a switch of the combination type. The switch-points and switch-blades are enclosed in a case so that the wiring will not be exposed to the thief. This case is mounted on the back of the dash cowl, leaving only the dials out in the front. The dials should be attached to the shafts



This Simple "Combination Switch" is Susceptible of Many Different "Settings;" all That the Owner has to do to Change the Setting is to Connect the Leads to Different Switch Points. The Dials of the Switches are the Only Parts Exposed on the Front of the Cowl Panel, Regular Radio Instrument Dials With Graduated Divisions Being Very Suitable for the Purpose. With the Connections Shown Above the Combination is 777.

in such a way that when the switch blade is on switch point O, the dial should indicate O on the dash board. In order to start the car using this wiring system, the dials will have to be turned to indicate 777. This switch can be wired in many different ways by simply disconnecting the wires of the switch points and connecting them on to whatever switch points one desires. The combination should be changed frequently.

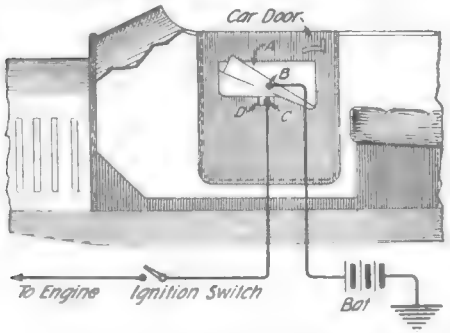
Contributed by EDWARD JOZWICK

Second Prize, $15.00.

DOOR FLAP SECRET IGNITION SWITCH

Many cars have a pocket in their doors and a flap to cover each pocket, a snap being provided to fasten the cover over the pocket. Why not use this snap as a means of closing the circuit? In the diagram herewith is shown the flap "A," "B" and "C," which are the parts of the snap and "D," is a small piece of cloth fixt, so that when the snap is open, it is between the parts of the snap. This switch is wired in series with the ignition switch.

Contributed by W. E. MERCK, Jr.



An Innocent Looking Switch Which May be Connected in the Ignition Circuit in one Way or Another, is Readily Improvised from the Snap Buttons on the Pocket Flap Inside the Door. This Flap and Button Being Found on Most Cars. When Leaving the Car the Flap is Pulled Open Which Prevents Starting the Car by Thieves.

NOTICE—CONTRIBUTORS ! ! !

We have not been at all satisfied with the class of suggestions we have been receiving lately in this department. Most of the devices that are suggested are very crude, and while some of them may be original, they are so impractical that not one in a hundred motorists would think of using or installing such a device. There is, however, one device that is needed badly which apparently has as yet not been invented. We refer to a device that would prevent stealing of motor cars. In the City of New York alone, there are stolen every day an average of 15 cars. The average for the entire country varies from between two to three hundred cars each and every day. This is a terrible loss and must be stopt at all cost.

For the next few months we will, therefore, give prizes only to such devices as prevent stealing of cars. We have publisht a few good ones in the past, but we feel sure that there are a good many others that should prevent thefts. It should be remembered always that motorists do not wish complicated and cumbersome devices; something that can be put in place quickly, and that can be removed just as quickly, is what is wanted. The device should, of course, always be secret so that the casual crook will not know how it is used. Variations of the device should be possible so that even after publishing such a device and giving it the fullest publicity, it could still be attached in such a way as to defy detection by the average man.—Editor.

FIRST PRIZE.....$25.00
SECOND PRIZE..... 15.00
THIRD PRIZE..... 10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

Third Prize, $10.00.

"STOLEN" SIGN BETRAYS THIEF

A simple idea to prevent stealing of motor cars is presented herewith. The

Here Is One of the Best Protective Stunts We Have Yet Seen—This Genius Paints the Word "Stolen" on the Rear of the License Plate, Which Plate is Pivoted at the Bottom and Held in its Normal Position by a Catch or Trip at the Top. This Trip is Connected With the Clutch Pedal When the Owner Leaves the Car; a Thief Pushing in on the Clutch, Will Cause the License Plate to Drop and Announce—STOLEN!

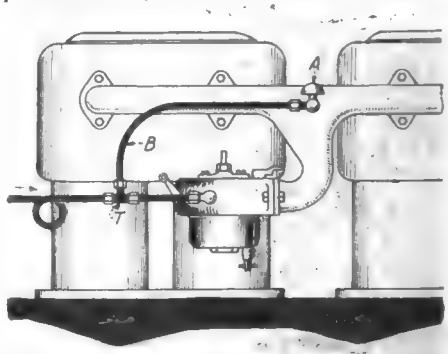
license plate is pivoted from the bottom and hooked at the top. When the owner leaves his machine, he will set the catch. When a thief comes along and starts the car, the plate will drop. On the reverse side is painted in large letters the word STOLEN. He can't go very far with that sign unconsciously displayed for the benefit of police and the public.

A light clutch or catch is arranged just over the license plate to hold it upward when in place and this release catch is connected by a wire or levers, etc., let us say, to the usual clutch pedal of the automobile. When the trip is set, or put in connection with the clutch pedal, and the thief steps in and starts the car, providing he has already solved some form or other of ignition switch mystery, and pushes in on the clutch lever, the trip will silently release the license plate which will drop over and read STOLEN. This trip could be rigged up quite easily to work with an electro-magnet for the trip lever with a contact device arranged at the clutch pedal for closing the circuit to the electro-magnet.

Contributed by M. F. JANNARD.

PRIMING ARRANGEMENT FOR EASY STARTING

The device consists of a double-ended petcock at A, with an elbow on it con-



Now That the Cool Weather is With Us Again, This Priming Scheme Will Prove of Interest, as it Will Conduce to Easier Starting. Gasoline is Squirted Into the Intake Manifold.

necting the gas line B, and also connected to the T in the main gas line from the tank. When the motor is cold and hard to start, turn the petcock while you give your motor about three quarter turns or one spin; then close the petcock and it is bound to start. I have used this device on my Ford for about a year, and have had my motor start on a cold day with but one turn when the switch was on battery. This saves all unnecessary priming with an oil can or the application of hot water to the intake manifold.

Contributed by ARTHUR J. HASTINGS.

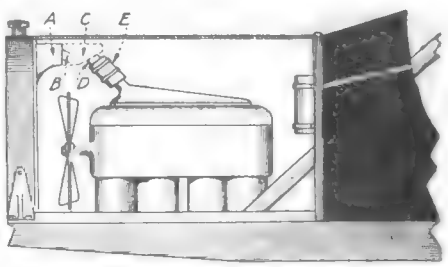
EXTRA WATER SPACE FOR OVER-HEATING CARS

Some cars are always over-heating. This can be easily remedied by welding an additional tank to the one already on the radiator.

First take off old hose connection (B) and drill the back of old tank (A) full of one inch holes.

Next make a one or two gallon tank (C) out of copper, fastening old hose connection on at (D). Then weld new tank to the back of the old one.

Swing hose to meet the new connection as (E) in the above sketch. On nearly all cars it will be found necessary to shorten the hose.



If You Have Sufficient Cold Water in Your Cooling System, the Engine Will Not Heat Up. Here is a Scheme for Adding More Water Space to the Radiator.

I never have been troubled with my engine over-heating since I fixt my radiator as shown in the illustration.

Contributed by A. J. KESTER.

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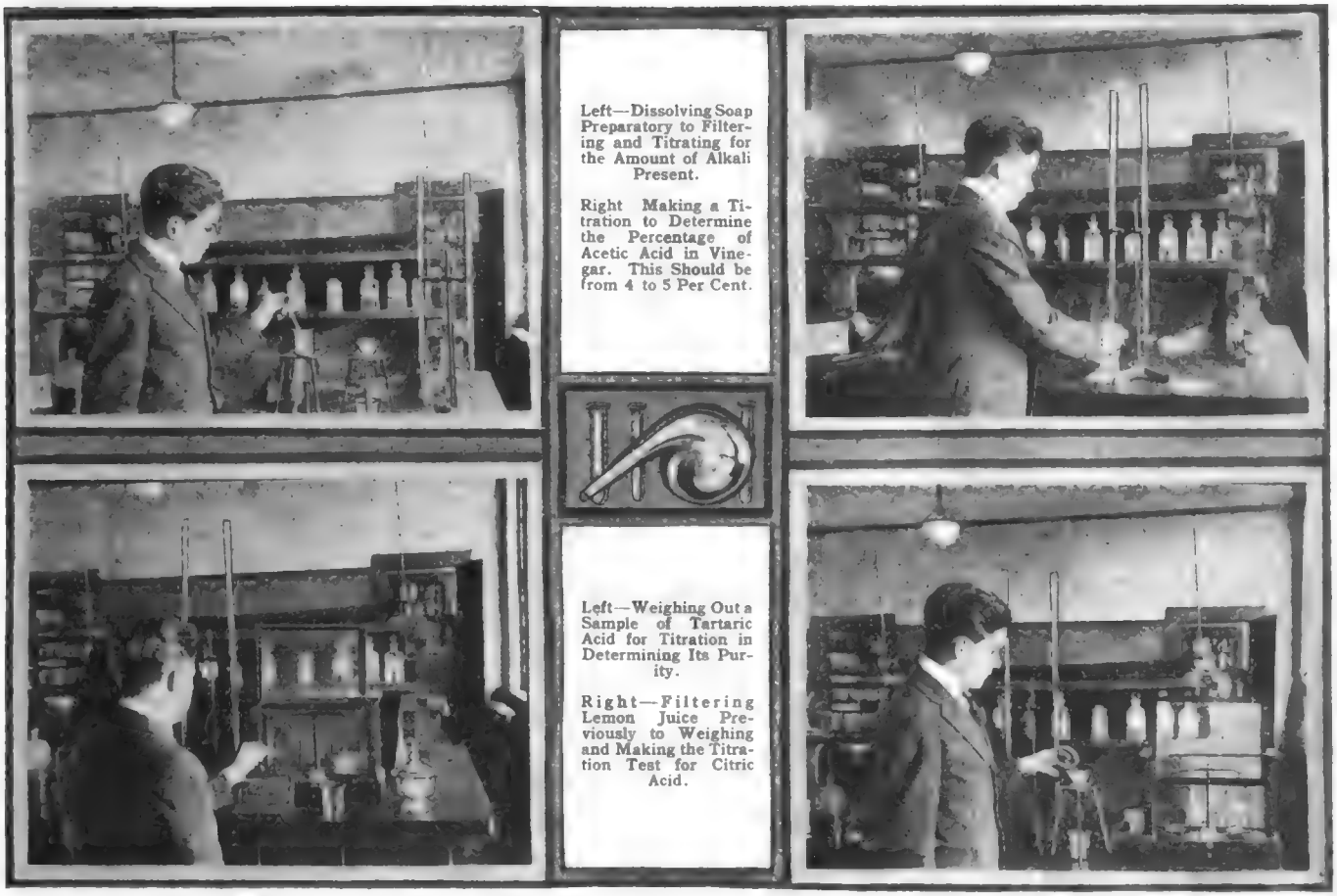
Practical Chemical Experiments

By PROF. FLOYD L. DARROW



Left—Dissolving Soap Preparatory to Filtering and Titrating for the Amount of Alkali Present.

Right Making a Titration to Determine the Percentage of Acetic Acid in Vinegar. This Should be from 4 to 5 Per Cent.

Left—Weighing Out a Sample of Tartaric Acid for Titration in Determining Its Purity.

Right—Filtering Lemon Juice Previously to Weighing and Making the Titration Test for Citric Acid.

TITRATION EXPERIMENTS

IN the last article of this series we had just started real analytical work by titration with standard solutions. In this issue we shall continue this very interesting subject and describe a number of analyses made by this method.

Determination of the Acidity of Lemon Juice: Exactly counter-poise with lead shot and bits of paper a small clean beaker. Then weigh into this 5 grams of filtered lemon juice. Add two drops of phenolphthalein and titrate as in the previous work with half-normal sodium hydroxid and hydrochloric acid. From the initial and final readings, estimated in each case to hundredths of a cubic centimeter, determine the volume of each solution used and subtract the volume of acid from the volume of base. Since 1 cc. of acid is exactly equivalent to 1 cc. of base the resulting volume of base obtained by the above subtraction will be the amount required to neutralize the citric acid in the lemon juice.

Now 1 cc. of half-normal sodium hydroxid will neutralize 0.035 gram of citric acid. Therefore, from the number of cubic centimeters used, calculate the number of grams of citric acid in the sample of lemon juice and then the percentage of acidity.

The acidity of other fruits may also be tested in this same way.

Determination of the Purity of Tartaric Acid. Weigh out exactly 2 grams of tartaric acid into a clean beaker and dissolve it in water. Add phenolphthalein indicator and titrate as before with half-normal sodium hydroxid and hydrochloric acid. From the initial and final readings of the two burettes find the total number of cubic centimeters of sodium hydroxid actually used in neutralizing the tartaric acid. Then from the fact that 1 cc. of half-normal sodium hydroxid will exactly neutralize 0.075 grams of tartaric acid calculate the number of grams of acid present in the sample and the per .cent. of purity.

Preparation of Tenth-Normal Solutions: For most volumetric work half-normal solutions are too strong. A drop of such a solution is five times as concentrated as a drop of tenth-normal solution and the end-point in titration cannot be obtained with nearly the fineness and exactitude that it can be with a weaker solution.

Therefore it will be well to prepare tenth-normal solutions of hydrochloric acid and sodium hydroxid. This is done in exactly the same manner as the half-normal solutions were prepared, except that only one-fifth as much of the acid or base are used to a liter of solution.

Determination of the Acidity of Milk: The acid found in milk is lactic acid and fresh milk should not contain over 0.2 per cent. Measure out with a graduate exactly 9 cc. of milk into a clean porcelain dish and rinse the graduate into it. Add phenolphthalein indicator and titrate with tenth-normal sodium hydroxid. Constantly stir the milk during the process of titration being careful not to lose any. Add the sodium hydroxid very slowly and stop at the first appearance of a permanent pink. The color should persist for one minute, and, if it does not, add another drop of the hydroxid.

The fact that 1 cc. of the one-tenth normal sodium hydroxid is equivalent to 0.1 per cent. of acid where exactly 9 cc. of milk have been taken, will enable you to calculate very readily the per cent. of acidity of the milk.

Testing the Strength of an Acid: An interesting exercise will be found in determining the strength of the dilute hydrochloric acid on your laboratory shelf. Weigh out into a clean beaker 10 grams of the acid and add two drops of methyl orange indicator. Titrate this time with half-normal sodium hydroxid, using the half-normal hydrochloric acid in securing the endpoint. Stop the titration at the point where a single drop of the base produces a distinct trace of yellow.

From the fact that 1 cc. of half-normal sodium hydroxid will exactly neutralize 0.01825 grams of hydrochloric acid, calculate the number of grams of acid in the sample taken and the percentage.

Remember that 1 cc. of half-normal acid exactly neutralizes 1 cc. of half-normal base. Therefore, in the above case to obtain the number of cubic centimeters of sodium hydroxid actually used in neutralizing the sample taken, you must subtract the volume of half-normal acid used in getting the endpoint from the volume of half-normal base.

Also remember that in filling burettes with standard solutions, not only must the burette be clean but it must be rinsed out with a few cubic centimeters of the solution itself before filling. Otherwise the strength of the solution will be weakened if the burette is wet.

(*Continued on page* 651)

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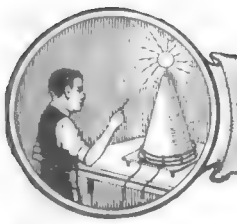
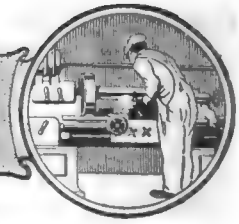


THE CONSTRUCTOR



How to Make a Model Theater

By Dr. ERNEST BADE

A VERY elaborate model theater can easily be made with nothing more than a box or two, a saw, and a sharp knife. In addition to this cardboard, and a number of magazines are essential. With these prerequisites, which are everywhere available, the most advanced stage can be built.

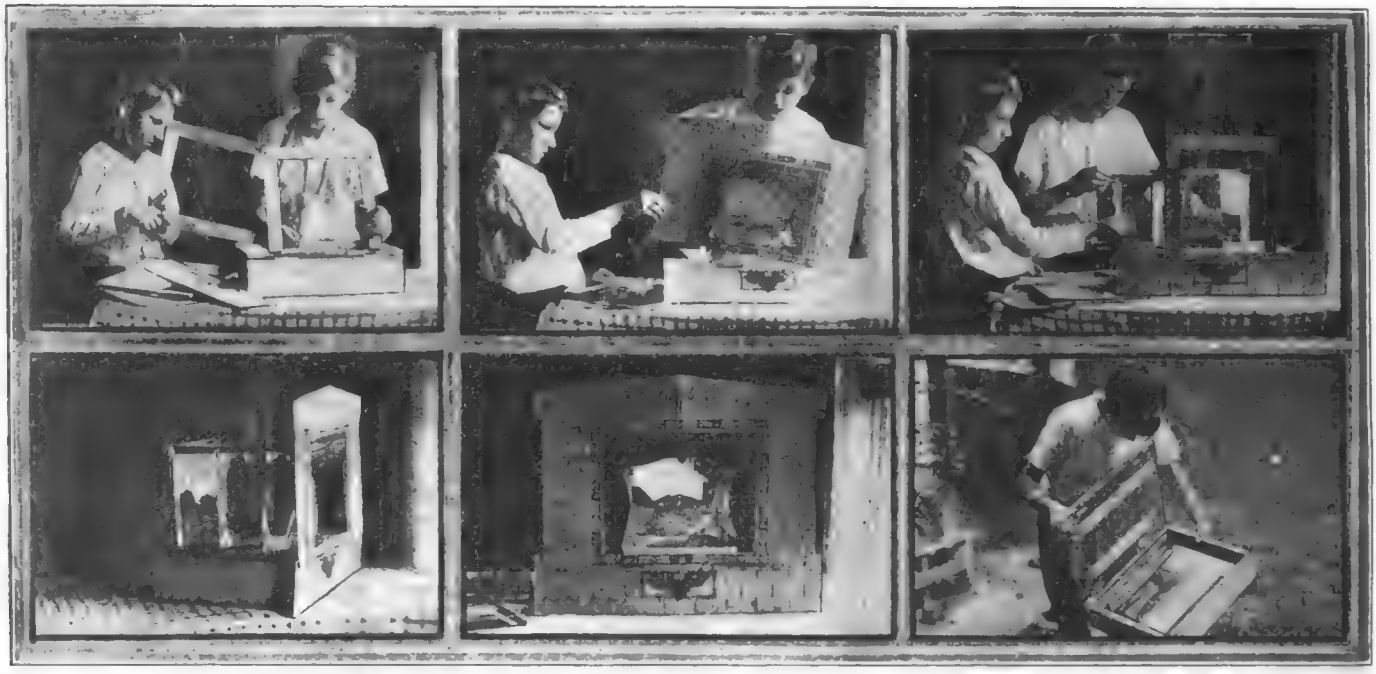
The first thing to be made, is a wooden box having a height of four or five inches if such a one is not at hand. The length and the width of the box are immaterial altho excellent results can be obtained from one having a depth of twelve inches and a width of fourteen inches. The cover, which should receive two slits on one end, should be hinged to the box at the front. Before the cover is attached to the box, it must be provided with three parallel grooves one-quarter of an inch wide. These are placed at equal distances from each other, the first is placed about one inch from the end of the box, the second is placed one-third of the way front, and the third is placed two-thirds from the front.

Then two squares, each eleven inches to the side, are made from loose slats. One of these is hinged to the front of the box and in such a way that it lies on top of it when folded, and when extended, it should be perpendicular to the cover. The other square must fit into the slits made in the cover. When the latter square is placed in position, it should only extend about eight inches above the box. These two squares must then be braced with two bars of wood each of which is a quarter of an inch thick, three quarters of an inch wide, and eleven inches long (just long enough to reach from square to square). Each of these strips are then provided with notches similar to the grooves on the cover and placed in corresponding positions. When this has been done, they are attached to the squares by means of hooks made from thin sheet tin.

The stage front is made from different colored pictures, wall paper, or other odds and ends, such as pictures from old magazines. These are assembled and pasted to stiff cardboard which must be considerably larger than the front supports of the stage. Dimensions of twenty inches wide, and seventeen inches high are sufficient. For convenience this has been divided into two parts, each of which can be folded together. The lower part, which not only just covers the box but extends quite some distance beyond, is four inches high and twenty-one inches long. This makes the lower part slightly longer than the upper part. To prevent the cardboard from tearing when it is folded too often, strips of calico are pasted to the back. When the theater is set up, both parts of the stage front need only be hooked to the supports. The theater opening is seven inches high and eight inches wide. In order to make this appear more realistic a few curved lines are added which give the whole an artistic and pleasing effect.

The back-grounds can now be made. These consist of large pictures, rural, interior, or street scenes are most useful, and those should be chosen which show the least number of people. These scenes are selected of proper size, are cut out and mounted on cardboard. They must all slide easily in the prepared grooves, and therefore should be mounted on a single piece of stiff cardboard. The side scenes, of which two are required for each background, should also be mounted in one piece. These are later cut hollow so that one can only see the sides, and they must be large enough so that one can not see the operator, nor anything else back of the stage.

Some of the backgrounds can be made of transparent material, and then the cardboard upon which the scenes are mounted, must be cut out so that windows, waves, stars, the sun or the moon can be lighted up if a candle or what is much safer, a miniature electric light, is held in back of the stage. The translucent paper gives very realistic effects by the exercise of a little ingenuity. One example will be sufficient. If the rising moon is to be represented in one scene, cut a strip of cardboard from the background before it is mounted, beginning with the horizon and cutting upward. A strip of one and a half inches should be sufficient. Then take a long strip of black paper, about a foot or eighteen inches long. In the center of this strip cut a hole to represent the moon, making it either quarter or full moon. Then paste a strip of cardboard about half an inch in width along the entire length of the cut out. This will leave about half an inch of clear free space, which can be lighted up from the back. Insert the strip of black paper, bring the moon below the horizon line, take a light, hold it in back of the scene, and gently pull the black



The Photographs Reproduced Above, and Taken by the Constructor of the Actual Miniature Theatre Here Described, Show What a Charming Little Playhouse Can be Made from a Few Pieces of Wood and Cardboard. Many Grown-Ups Find Hours of Amusement With Miniature Theatres Built on a Little Larger Scale, as do the Younger Folk, for There is a Fine Opportunity for Many Ingenious Features. Novel Electric Lighting Arrangements are Included, and Singing and Speaking for the Various Characters May be Produced by a Concealed Phonograph.

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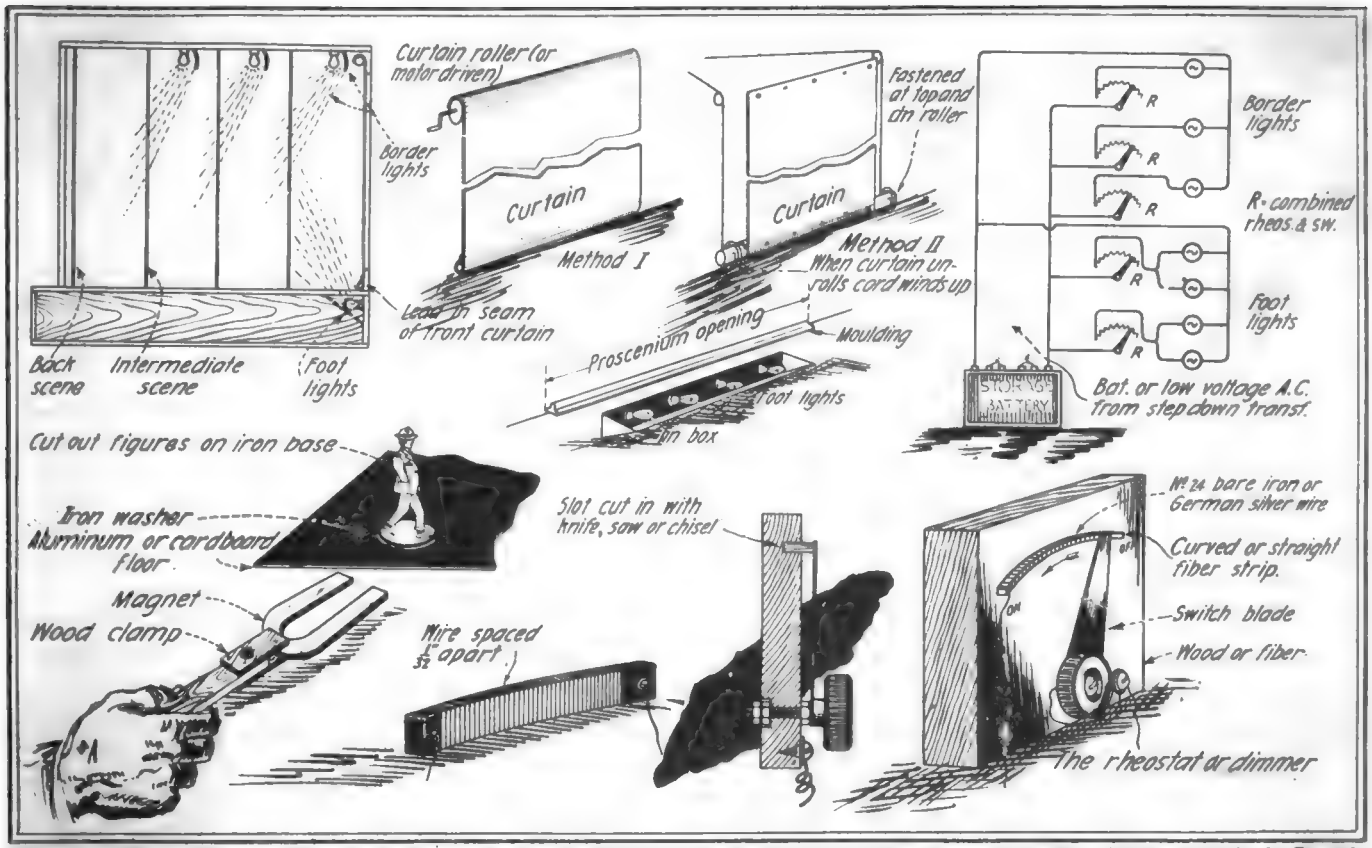


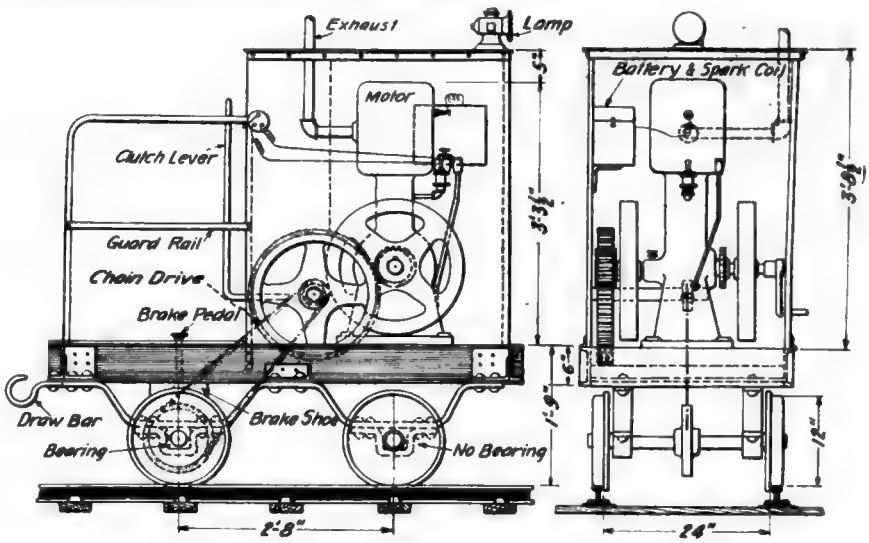
A Number of Different Features, Which Can be Employed in Operating Miniature Theatres, are Shown in the Diagram Herewith. The Front Curtain, for Example, May be Raised and Lowered in Several Different Ways, as Indicated in the Drawings. By Using Either Standard Toy Motor Rheostats or Building One or More of Them from the Data Given, the Foot- and Border-Lights Can be Extinguished or Dimmed to Any Degree Desired. By Using a Steel Magnet Clamped on the End of a Stick, as Shown at the Left, and by Mounting the Cardboard or Other Figures on Iron Washers or Disks, the Characters Can be Caused to Move About the Stage, as if by Magic. The Bulbs Used on the Miniature Stage Can be Lighted from a Step Down A. C. Transformer or Else from Dry or Storage Cells.

strip of paper upward. The audience will see the moon rise, and wonder.

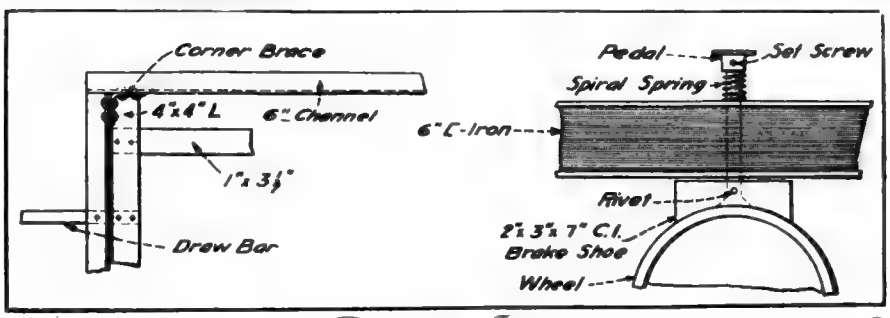
The last, and the most important detail is the lighting of the stage itself. The electric supply can be obtained from three dry cells, which can be placed in the box. Two small bulbs should be sunk into the exact center and in front of the stage. Two other bulbs are placed above the scenes, one between the background and the line of the last side scenes, and the other between the lines of the second and the first side scene. The two bulbs used over the stage should be white, the other two in front of the stage are respectively white and blue. With the aid of a dimmer attached to the *white lights* only, a gradual darkening of the stage can be effected until all the white lights are turned out, leaving only *one blue light burning.*

Small Gasoline Locomotive

I USED some old industrial wheels and axles, a gasoline motor from a concrete mixer (6 H. P. vertical type, with double fly wheel and 2½" face); a gear wheel of 6" diameter was on outside of fly wheel opposite crank. This gear wheel meshes into a 20" gear wheel on a counter-shaft which has a clutch and a 5" sprocket. The gasoline engine is mounted on the 6" channel iron frame by angle iron cross-braces, riveted to frame with 3/8" rivets as are the counter-shaft bearings. Axles and wheels are attached by the four 1" flat iron suspending braces, the rear ones having a brass block bearing, while the front is plain; the wheels turn on the round ends, the inside portion being square. Use a large sprocket keyed on rear axle 8" or 9" diameter. The cab over engine is of heavy sheet iron, with two doors on hinges with catches. Make the driver's platform of 3/16" steel cut out at edges as necessary. Provide 1" diameter draw bar; bolt all parts into frame assembly and rivet over ends of all bolts.



A Small Gasoline Locomotive Which Can be Run on Wooden Tracks.



The engine has the gasoline supply in tank below crank case (or engine base), and it is pumped therefrom to carburetor. Battery and coil are in box as illustrated, and switch is located near operator; as the engine has a good governor, no throttle or spark control is necessary. Allow clutch to engage gradually. With care and common sense this machine will draw two or three industrial cars at four to five miles per hour and pay for itself in a short while.

Contributed by P. P. AVERY.

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Preparing Objects for the Microscope

By EARLE R. CALEY

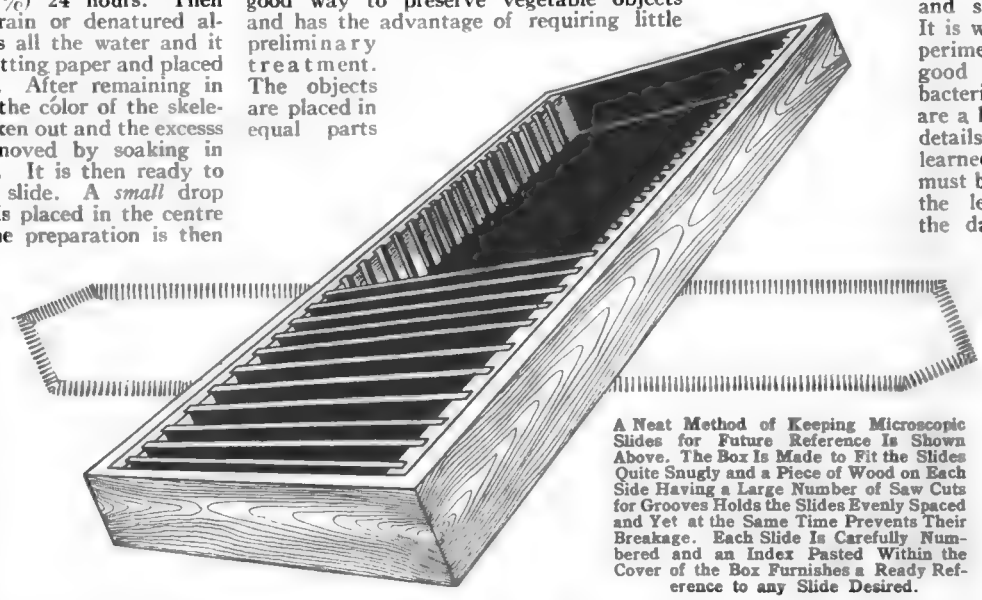
(CONCLUDED)

Method II—Mounting in Resins and Gum Resins

The two resins chiefly used in this work are Canada Balsam and Dammar. These are usually used dissolved in some volatile solvent like benzol altho Canada Balsam can be used alone for mounting rock sections, tooth sections and similar objects not injured by a fairly high heat. We will take for instance a foreleg of an insect such as a beetle. After detaching the leg of the beetle the first step is to soak it in potash solution (see formulas) for 24–48 hours. Then wash with water and soak in dilute spirit (2.5%) 24 hours. Then transfer to strong grain or denatured alcohol. This removes all the water and it is then drained on blotting paper and placed in oil of turpentine. After remaining in the turpentine until the color of the skeleton is reduced it is taken out and the excesss of turpentine is removed by soaking in benzol several hours. It is then ready to be mounted on the slide. A *small* drop of balsam in benzol is placed in the centre of a glass slide. The preparation is then taken with the forceps and placed in the balsam drop. Another drop of balsam is placed on this and a *clean* cover glass dropped in place, taking care to drop the cover parallel to the slide surface. Then press down the cover with a fine brush and grasp the slide with the spring clip illustrated last month. The slide is heated over a spirit lamp until the benzol *just commences* to boil and then put aside to set. After the balsam has thoroly set, the excess balsam is cleaned off with a scalpel and a piece of cotton moistened with alcohol. Then the slide is mounted on the turntable, a ring of shellac applied and finally the finishing varnishes added as before. This shows the hot process of mounting. As an example of the cold method the mounting on corn starch in Dammar and benzol will be told. First make a mixture of corn starch and distilled water and place on a glass slide and thoroly dry in a desiccator for about a week. Then place a drop of benzol on the starch and before it has time to thoroly evaporate add a drop of Dammar and benzol, place on a cover glass, grasp with the spring clip and set aside for several weeks. The excess of Dammar is then removed and the slide finished as previously described. Objects may also be mounted by this method, using a cell and placing the object in the cell, filling the cell with balsam in benzol, setting aside to harden and finishing as before.

Method III—Mounting in Aqueous and Other Fluid Media

By this method objects are preserved in various preserving media, such as carbolized water, glycerine, osmic acid solution and various special preservatives, like Farrant's medium. Taking the easy example of starches again the mounting of them by this method is as follows: A varnish cell is filled with carbolic acid solution (dilute) and the starch added to the liquid in the cell until it is just milky. A suitable cover is then selected, edged with shellac and prest down on the cell, the excess fluid is then dried off the slide with blotting paper and a ring of shellac added as a seal. The finishing varnishes may then be applied. Animal tissue is a substance very suitable for mounting in glycerine. The tissue is soaked for a time in a mixture of equal parts of water, alcohol and glycerine and then placed under a bell jar. By this means the pores become filled with glycerine and the object is then mounted in a cell full of pure glycerine. When finishing cells prepared with glycerine an extra wide and heavy band of finishing varnishes should be applied on account of the tendency of glycerine preparations to leak. Mounting the objects in glycerine jelly is a very good way to preserve vegetable objects and has the advantage of requiring little preliminary treatment. The objects are placed in equal parts of water, alcohol and glycerine for about two hours. They are then taken out and placed on the glass, the superfluous liquid being absorbed by blotting paper. The glycerine jelly is then made fluid by heating in a hot water jacket (simply placing the bottle in a vessel of boiling water) and dropped with a glass rod on the object. When the jelly has set the superfluous jelly is taken off by brushing with a stiff brush under water. The slide is then finished as usual.



A Neat Method of Keeping Microscopic Slides for Future Reference Is Shown Above. The Box Is Made to Fit the Slides Quite Snugly and a Piece of Wood on Each Side Having a Large Number of Saw Cuts for Grooves Holds the Slides Evenly Spaced and Yet at the Same Time Prevents Their Breakage. Each Slide Is Carefully Numbered and an Index Pasted Within the Cover of the Box Furnishes a Ready Reference to any Slide Desired.

Preserving the Finished Slides

After the amateur has prepared a number of slides he will need some sort of a cabinet to keep them in. It must be remembered that microscopic slides are delicate objects and should be handled very carefully, the thin cover glasses especially being very liable to breakage. An easily made cabinet to hold a moderate number of slides is shown in the drawing. The slides should be numbered consecutively with small gummed labels, and the data regarding the slides set down in a note book or placed on the cabinet cover. Large paper labels should not be placed on the slide itself, as they not only spoil the appearance, but are liable to absorb moisture and spoil the preparation. The data set down regarding the slide should name the preparation, using both the common and scientific name, give the date collected and the place or origin, the preserving medium and the magnifying power to be used and any other data regarding the preparation which will enhance the value of the slide.

BACTERIOLOGICAL SLIDES

In this sort of work great care must be exercised in preparing the microscopic slides and also in preventing infection which may result disastrously. A sample of sputum is then placed in what is known as a culture medium which may take on the form of a liquid or a jelly and may be contained in test tubes or in petri dishes, which are then placed in a suitable oven which will keep the temperature at about 78° F. for from several hours to three or four days. During this time the growth of the bacteria becomes quite prolific and the colonies may even be observed by the naked eye, altho the details of their structure cannot be learned until they are mounted upon a slide and suitably stained. It is well that the experimenter read up a good authority on bacteriology, as there are a large number of details which must be learned and which must be carried out to the letter, otherwise the danger to infection to either the experimenter or anyone in the vicinity is astoundingly great. A smear is then made across one of the slides with some of the solution from the germ culture or preferably a portion of a colony of germs is removed by means of a platinum wire and smeared upon the slide. The slide is now heated to permanently fix and kill any bacteria upon it, and suitably stained.

Reagents and Varnishes Used in Making Microscope Slides.

Potassium Hydrate Solution.

KOH or NaOH	2 oz.
Water	1 qt.

Iodine Solution.

Iodine	40 grs.
Potassium Iodid	60 grs.
Water	1 Pint

Dissolve the dry substances in a small amount of water and then add the remainder.

Glycerine Jelly (Lawrence's)

Gelatine	1 oz.
Glycerine	6 drachms
Spirits of Camphor	¼ oz.

Cover the Gelatine with cold water and allow it to soak until it becomes soft. Dissolve by placing the jar containing it in a vessel of boiling water, allow it to cool and then add a small quantity of white of egg and boil until the albumen coagulates, then filter thru flannel and mix with the glycerine and spirit.

Cell Varnish.

Dissolve shellac in wood alcohol until the required consistency is reached.

(Ordinary shellac may be used for this purpose.)

Balsam and Benzol.

After baking Canada Balsam in an oven dissolve to a fairly thick consistency with benzol.

Damar and Benzol.

Gum Dammar	1 oz.
Benzol	2 oz.

Carbolic Acid Water (Conc.).

Phenol	1 drachm
Water	16 oz.

Carbolic Acid Water (Dilute).

Dilute above with ten volumes of distilled water.

Finishing Varnishes.

Use the ordinary high gloss varnish enamels, as sold upon the market for this purpose.

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HOW-TO-MAKE-IT

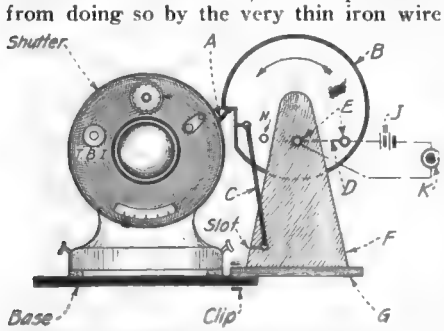
This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

NOVEL ELECTRIC SHUTTER RELEASE

The usual type of electric shutter release makes use of an electro-magnet, which, when excited, releases a small catch and thus enables a spring under tension to move the shutter lever. Such a release is very heavy, as the iron and copper of the electro-magnet weigh a fair amount, too heavy in fact, to be used on a light and dainty camera of say, vest pocket size. Another, and still greater disadvantage is the noise.

The author set to work to design an entirely noiseless electric shutter release and can claim to have been very successful. The general arrangement of the release is shown in the sketch, where A is the release lever and B a small wooden disc pivoted at its centre. C is a rubber band which tends to rotate the disc in the direction of the arrow, but is prevented from doing so by the very thin iron wire



For Bird and Animal Photography, it Is Imperative That any Form of Automatic Shutter Release for the Camera Should be Noiseless. The Author of This Article has Designed a Clever Shutter Release Operated by Means of a Fuse Wire "D," Which of Course Performs Its Function of Releasing the Shutter in a Perfectly Silent Manner, When the Button "K" Is Pushed. A Rubber Band "C" Actuates the Release Drum "E."

D which is held between two binding posts E. A wooden support F carries the pivot of the disc B, and the whole release is mounted upon a thin base G, which, in turn, is fixed to the camera base by a small clip. The thin iron wire D is connected in series with a small flash-lamp battery J, and a push button K. If we press the button, a current will flow from the battery thru the button and the wire, and the latter will burn thru, as it is very fine.

As soon as this occurs, the rubber band C will turn the disc B, till a stop H comes to rest against the standard F; in rotating, the lever A will be depressed and the shutter released. The explanation given here takes, of course, a certain amount of time to read; actually, the wire will burn thru and the shutter will be released immediately the button K is pressed. If it is desirable that not even the faint flash of the fusing wire shall be visible, then a short length of rubber tubing may be placed over the wire between the two posts E.

To make the shutter, the dimensions will be governed by the height and width

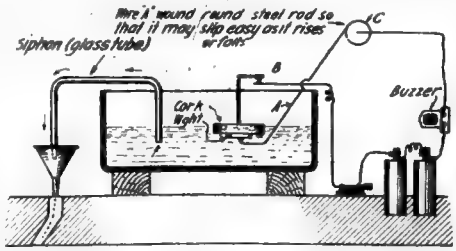
(*Continued on page 664*)

SECOND PRIZE, $3.00

SIPHON ALARM CLOCK

I, like a good many other fellows, am troubled by the fact that lying in bed becomes extremely comfortable in the mornings, and I fail to wake up. So I fixt up this alarm which works very faithfully.

As the water level goes down, due to the



The Siphon Alarm-Clock Here Shown, Is an Ingenious and Interesting Device. The Siphon Tube Should of Course be Very Small in Bore.

syphoning process, the cork sinks. Running thru the cork is a copper wire which is bent at right angles at the top. When sufficient water has syphoned off, the wire attached to the cork will make contact with another wire (B) which is stretched across the water vessel. This closes the circuits and rings the buzzer.

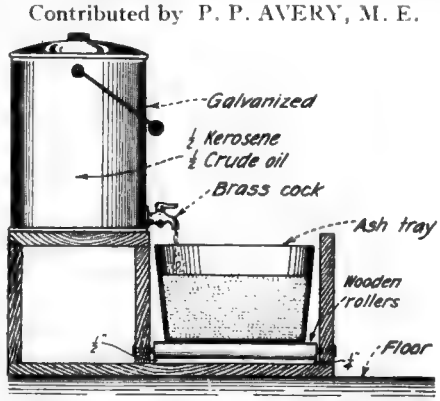
Setting this alarm takes rather a long time, but once it is done, no more trouble is experienced. To set it so that it will ring at say about seven hours from a certain time, it is necessary to fill the water vessel to the very top. Then set the syphon going and note the time of starting. After seven hours note how much water has syphoned off. Then bend the wire (A) in such a position that it will make contact with (B) when that much water has syphoned off.

Contributed by R. THORNTON.

HOME-MADE KITCHEN UTENSIL

Ashes treated with kerosene, after being sifted, are better for starting the fire than kindling wood. The ashes are well shaken thru a standard sieve and then rolled to and fro sideways a little on the rollers, while the kerosene drips on them. When just enough has dript, so that they have absorbed all they can hold, turn off the cock. A shovel or two of these thrown on a clean grate makes an ideal fire at once.

Contributed by P. P. AVERY, M. E.



Ordinary Ashes Treated With Kerosene, After Being Sifted, are Superior to Kindling Wood for Starting a Fire, says Mr. Avery.

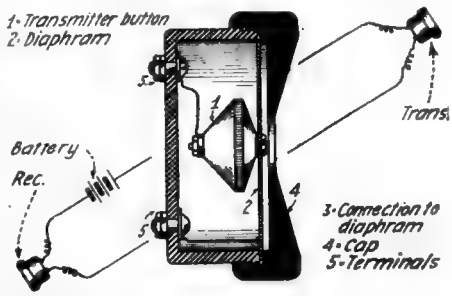
THIRD PRIZE, $2.00

HOME-MADE ELECTRICAL STETHOSCOPE

The following simple device will be found a boon in locating motor knocks and clicks, as the trouble can be easily and quickly located. First procure an old wireless headset (which is usually to be found about the shop, or may be purchased for a couple of dollars) and remove the magnets from the shell of one of the receivers, then carefully drill the exact center of the diafram to receive the protruding threaded end of a Skinderviken transmitter button. Next, fasten the button, make connections as per diagram, and replace cap. A sufficient length of cord should be left between the instruments to allow the transmitter to be freely moved about.

To use this stethoscope, place the transmitter upon the doubtful part, and move about until the loudest click is heard in the receiver.

Contributed by HAROLD LAWSON.



Here's How to Make an Electrical Stethoscope Which Will be Found Very Useful in Locating Motor Knocks and Other Noises. It Comprises a Microphone Made as Shown, Which Is Connected With a Battery and a 75 Ohm Telephone Receiver.

HINTS ON STAINING WOOD.

IT is often desirable for the amateur mechanic and experimenter to finish the wood of the articles he produces. I wish to tell about wood staining in the most practical manner; reasonable care will produce the best results. The stains in common use are oak, cherry, walnut, and mahogany. The woods to which the stains can be applied may be of any variety, thus, white pine, yellow pine, cypress, poplar, and maple are known as close grained woods. That is, their pores are not large and are easily filled. Oak, chestnut, ash, and walnut are known as open grained woods, and are treated differently.

The vehicle or thinner for these stains is raw linseed oil, turpentine, and Japan dryer. The pigments or colors used are ground in raw linseed oil, and may be purchased at most hardware or paint stores in one pound cans. The following are the pigments you should have on hand to produce any of the above stains: Raw sienna, burnt sienna, burnt umber, vandyke brown, and rose pink.

Suppose you have built a cypress medicine cabinet, and wish to stain it cherry. The base for cherry stain is burnt sienna

(*Continued on page 674*)

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Wrinkles, Recipes Formulas

EDITED BY S. GERNSBACK

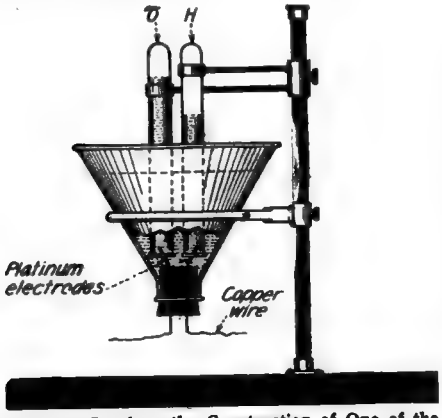
A SIMPLE ELECTROLYTIC APPARATUS

A simple electrolytic apparatus to accompany Prof. Darrow's article on Electrolysis which appeared in his series of Practical Chemical Experiments is described below.

Obtain a funnel about 3" in diameter, file and break the stem off. A large electric light bulb with the bottom and top cut off or an Erlemeyer flask with the bottom out would do as well as the funnel. Insert a cork into the end of funnel, bulb or flask with two very small holes burnt in it. Set this funnel and cork in one of the rings in your ring stand as in the diagram. Now obtain two pieces of platinum wire and insert into the cork attaching two longer pieces of copper wire to them. Fill the flask with acidulated water. Over the two platinum wires, clamp two test tubes of equal size about 5" long by ¾" wide full of acidulated water also. Now attach the copper wires to the batteries and carry out Prof. Darrow's experiments.

Contributed by R. K. INNES.

[*Copper or iron wires may be used instead of platinum, if a solution of sodium hydrate or potassium hydrate is used instead of a dilute acid.*—EDITOR.]



This Idea Involves the Construction of One of the Simplest Electrolytic Apparatus for Carrying Out the Electrolysis of Water, Which We Have Yet Seen. No Wires Have to be Sealed in Glass Tubes and Two Ordinary Glass Test Tubes Fill the Bill.

REMOVING STAINS FROM TILES, WHITE MARBLE, ETC.

Ink stains can be removed by dissolving 1 oz. of antimony trichlorid and 2 oz. of oxalic acid in 1 quart of water, adding sufficient flour to make a paste, and covering the stain with the mixture, leaving on for a few days until the spot is removed.

Other stains are removed by the following process: Make a paste of turpentine oil, 9 fl. dr., lye, 6 fl. oz., ox gall, 1½ fl. oz., and enough pipe-clay; apply to the stain, and allow to remain several days.

Oil stains can ordinarily be removed by applying common clay, saturated with benzin.

Acid stains can be removed only by repolishing, with powdered rotten-stone, ferric oxid, etc.

NON-INFLAMMABLE CELLULOID

Dissolve ordinary celluloid in acetone, in the proportion of 25 grams of the former to 250 grams of the latter. Then dissolve separately 50 grams of magnesium chlorid in 150 grams of alcohol and form a mixture of the two solutions. When the volatile solvents have evaporated, there remains a celluloid which is non-inflammable.

CEMENTS FOR PORCELAIN AND GLASS

1—Use white of egg beaten up witn an equal quantity of water and add enough slaked lime to make a paste; apply immediately. Presumably, whey might take the place of water, on account of the albuminoids contained.

2—Mix rapidly white of egg with plaster of Paris, containing one-fourth its weight of freshly slaked lime.

3—Mix white of egg with scraped lime or calcined plaster of Paris.

4—Work together freshly prepared casein and freshly calcined lime with water to make a thick paste. Use at once.

5—Mix equal amounts of dry powdered casein and slaked lime and make into a paste with water.

Whey or skimmed milk might be better. Solutions of borax or of water-glass also are mixed with casein for cements.

These casein and albumin cements are pronounced excellent for mending porcelain and glassware, but must be employed immediately.

WATERPROOF CEMENT

Alcohol	1000 parts
Sandarac	60 parts
Mastic	60 parts
Turpentine	60 parts

Dissolve the gums in the alcohol and add the turpentine and stir in. Now prepare a solution of equal parts of glue and isinglass by soaking 125 parts of each in cold water until it becomes softened, pouring and pressing off the residue, and melting in the water bath. This should produce a volume of glue nearly equal to that of the solution of gums. The latter should, in the meantime, have been cautiously raised to the boiling point in the water bath, and then mixed with the hot glue solution.

It is said that articles united with this substance will stand the action of cold water for an unlimited time, and it takes even hot water a long time to affect the joint.

GOOD CEMENT FOR LEATHER

Glue	1 oz.
Starch paste	2 ozs.
Turpentine	1 dr.
Water, a sufficient quantity,	

Dissolve the glue in sufficient water with heat; mix the starch-paste with water; add the turpentine, and finally mix with the glue while hot.

ANOTHER LEATHER CEMENT

Leather belts and other parts can be repaired with the following:

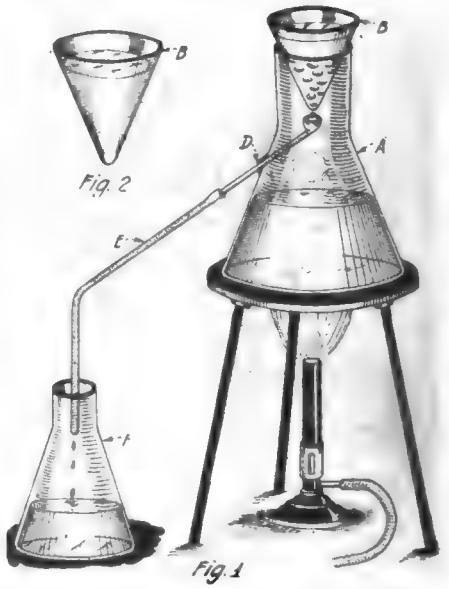
Carbon disulfide	10 parts
Oil of turpentine	1 part

Gutta-Percha, cut in small pieces, q. s.

Mix the turpentine and carbon disulfide, and add sufficient gutta-percha under frequent agitations, or rubbing up, until a thick paste is obtained. To make a good joint all fatty and greasy matter must be got rid of, and the surface of the leather freshened, either by the use of a rasp, emery paper, or knife, before applying the paste. It should be burnished over the joint with a hot iron.

A DISTILLING APPARATUS

Herewith is a diagram of a very interesting piece of chemical apparatus which I have used for quite a long time for distilling water and other liquids. First, heat the glass to redness and blow a hole in the side of an ordinary flask; then securing a thistle tube, bend as shown in the illustration, and insert into the hole thus blown. It is imperative that the mouth of the flask be large enough to permit the insertion of the thistle tube. The glass is then sealed up around this opening firmly joining the thistle tube to the flask. A cone shaped glass receptacle is now either obtained or made which will contain ice or cold water for condensing the evaporated liquid. This receptacle is filled with cracked ice or with water, which may be allowed to pour into it and in turn out again thru a siphon. A rubber hose is connected to the thistle tube so as to collect the condensed liquid. The cone shaped condenser may be removed whenever desired, to allow for the introduction of water or other liquid into the flask, and also for washing it or filling with cracked ice or water.



A Home-Made Distilling Apparatus which has Given the Author Good Results, so He States, When Used for Distilling Water and Other Liquids.

Contributed by A. GRASSO.

REMOVING STUMPS OF TREES

I herewith submit two formulas for removing stumps chemically. 1—In the fall of the year bore a 1" hole 18" deep, into the center of the stump; put in an ounce of potassium nitrate (saltpetre). Fill up with water and plug the hole. In the spring take the plug out and put in a half gill of kerosene, and set fire to it. It will burn the stump out to the farthest root.

2—In the fall, with an inch auger, bore a hole 10" deep and put into it ½ pound of sulfuric acid (Oil of Vitriol) and cork up very tight. In the spring the whole stump and roots extending all thru their ramifications will be found so rotten they can be easily removed.

Contributed by C. E. GIBBS.

[*We suggest that a greater quantity of potassium nitrate should be used in the first formula.*—EDITOR.]

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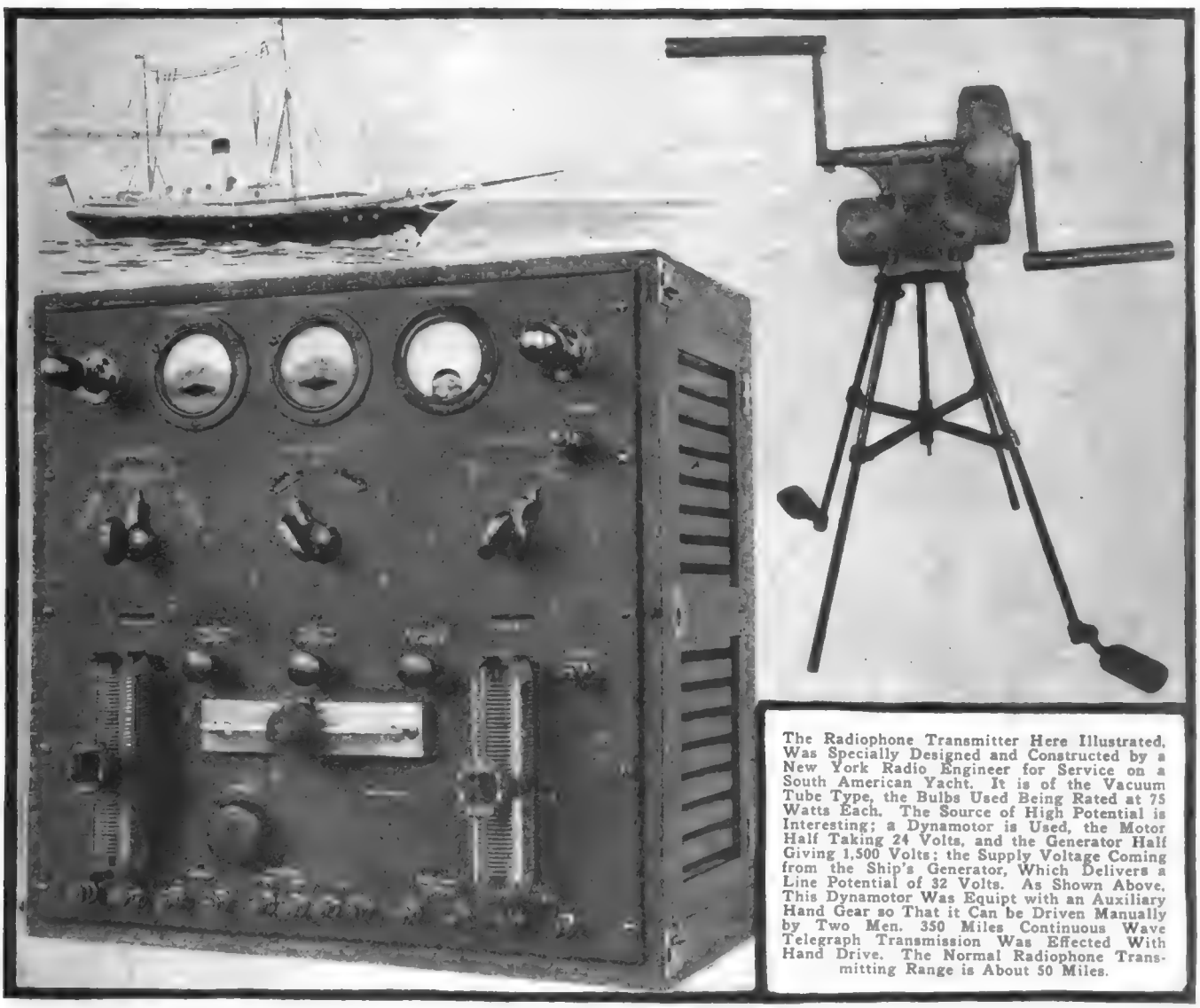
RADIO DEPARTMENT

A Yacht Radiophone

By C. GOLDEN



The Radiophone Transmitter Here Illustrated, Was Specially Designed and Constructed by a New York Radio Engineer for Service on a South American Yacht. It is of the Vacuum Tube Type, the Bulbs Used Being Rated at 75 Watts Each. The Source of High Potential is Interesting; a Dynamotor is Used, the Motor Half Taking 24 Volts, and the Generator Half Giving 1,500 Volts; the Supply Voltage Coming from the Ship's Generator, Which Delivers a Line Potential of 32 Volts. As Shown Above, This Dynamotor Was Equipt with an Auxiliary Hand Gear so That it Can be Driven Manually by Two Men. 350 Miles Continuous Wave Telegraph Transmission Was Effected With Hand Drive. The Normal Radiophone Transmitting Range is About 50 Miles.

THIS particular Radiophone Transmitter was designed and constructed for an official of one of the South American countries and was installed in his yacht. In drawing up the specifications many important factors had to be considered, including small space available for the apparatus, limited technical knowledge of the crew and most important, an auxiliary means of operation in case the ship's electrical mains failed.

Fig. 1 shows the front view of the transmitter unit, whose panel size is only 22x22 inches and whose case is 8 inches deep. Two small dash-board type pilot lamps are supplied for illumination when using the auxiliary source of power. In addition to the radiophone transmission, signalling is also possible on straight CW or ICW and all these features are instantly available thru the three control switches.

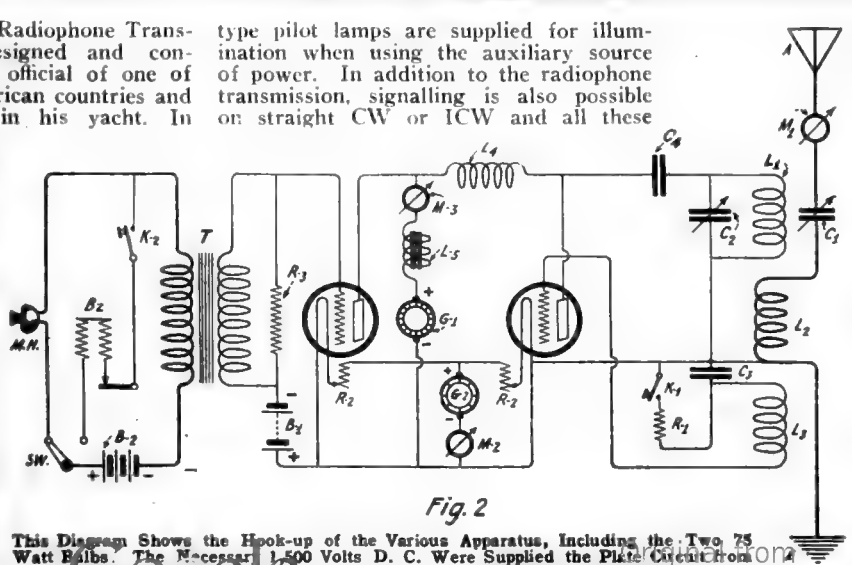


Fig. 2

This Diagram Shows the Hook-up of the Various Apparatus, Including the Two 75 Watt Bulbs. The Necessary 1,500 Volts D. C. Were Supplied the Plate Circuit from a Dynamotor, G. T. Fig. 4 Choke Coil, L-5, and Milliampere-meter, M-3.

Two German transmitting tubes were used and were worked at approximately 75 watts each, although capable of a considerable overload. The plate potential impressed upon the tubes was 1500 volts direct current normal, and at this voltage the space current of the oscillator was 148 milliamperes approximately. The filament supply voltage of these tubes was 24 and at that figure when new, drew approximately 5 amperes each. The normal antenna current was two to three am-

(*Continued on page 673*)

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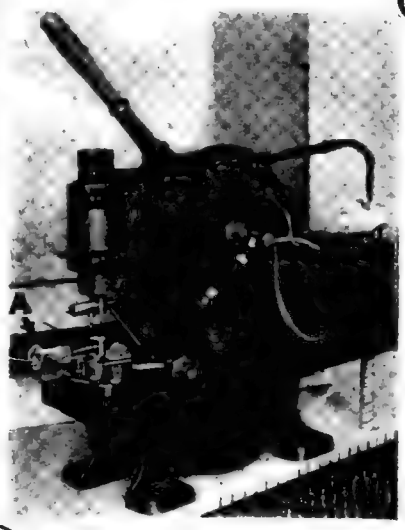
The Illustration at the Right Shows Group of Operatives Assembling Vacuum Tube Parts, and on the Bench Before Them are the Latest Type Electric Welding Machines; a Close-up View of One of These Welders Being Shown Below. Thanks to the Speed of the Electric Welder, Thousands Instead of Hundreds of Vacuum Tubes Were Manufactured at One Plant Daily During the World War.

The Vacuum Tubes Shown Below, Represent Two Distinct Types in Which the Internal Elements are Electrically Welded with the Machine Shown in the Central Photo. Both Transmitting and Receiving Bulbs Have Had Their Production Speeded Up Wonderfully, Due to the Rapidity and Efficiency of Electrically Welding the Metal Plates and Spirals to the Supporting Wires and Connections.



The Electric Welder is Shown Above, and This Compact and Efficient Little Machine Occupies an Area of About 10" by 12" and Does Not Stand More Than 12" High. By Close Observation One Will See a Part of a Vacuum Tube Placed on the Jig Ready for the Electric Welding Operation. A Nickel Helix and a Nickel Cylinder or Plate, Together With a Tungsten Filament, Comprise the Main Members Which are Electrically Welded to the Supporting Wires and Connections. One of the Remarkable Features of Electric Welding Is the Fact that Different Metals May be Welded to one Another Easily, Such as Tungsten to Nickel; Copper to Nickel; Molybdenum to Nickel; Iron to Molybdenum, etc.

Arc Welding of Audion Parts

By F. A. ANDERSON

ELECTRICITY has given to man light, heat and power, and thru the application of these, numerous devices which contribute to the comfort and convenience of our daily life. Out of this storehouse has come two arts, which have been so highly developed that each has produced a separate profession of its own. I refer to the art of *electric welding* and that of *radiotelegraphy* and *telephony*. The object of this article is in a way to show how *arc welding* has assisted in the perfecting of the radio apparatus.

Two important functions of the radio art are amplification and detection. To accomplish these there have been developed what are known as vacuum tubes or valves. These are made in three principal types—two of which are used in receiving, and one in transmission service.

It is necessary in the manufacture of these tubes to join together certain metal parts which are very small in sectional area and which require difficult and expert operation. On account of the delicate character of this work it has been found that female help is the most efficient.

The Moorhead people of San Francisco have for a long time recognized the efficiency of female help and thru the courtesy of this company I am able to present these views, taken in their factory. The first shows a group of women sitting at a table operating the electric welding machines and assembling the parts for the vacuum tubes, the second shows an inspector examining a partially completed tube, and the third the scientific testing, which each tube undergoes before it is allowed to go out into service.

The electric welder for doing this work is a compact machine and occupies an area of about 10 x 12 inches and is not more than 12 inches high. The accompanying illustration shows one of these machines and by close observation you can see a part of one of the tubes placed on the jig, ready for the electric welding operation, while on the right of the machine is a tray holding the parts ready to be welded.

DETECTOR, AMPLIFIER AND TRANSMITTING TUBES

Probably the most important of the two receiving tubes is the detector, which is [illegible] and intensify the high fre-

(Continued on page 678)

List of Articles Appearing in November Issue of "Radio News"

A Short Wave Receiver
By Jesse Marsten
Construction and Use of a Wavemeter for Short Waves
By Robert E. Lacault
A Study of the Antenna System
By C. M. Grabson
The Radio Constructor
Junior Department
With the Forest Service
By O. D. Tron

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What to Invent

By JAY G. HOBSON

FARM WATERING SYSTEM

THE intense drought that we have had with us the past summer plainly designates the great need for an improved farm watering system. Out West they use irrigation to furnish the crops with moisture, but in the East and Central West, farmers are dependent upon the generosity of the rain-clouds for their supply of the aqueous necessity. While it is true that many truck-gardens are equipt with an overhead sprinkling system of pipes, and this works very satisfactorily, yet to adopt a similar system for a two hundred acre farm would hardly be practicable, because the network of pipes necessary to water the ground properly would be in the way of plowing and tending the crops.

However, it appears to me that this objection could easily be overcome by piping the ground in a manner described and illustrated here. As shown the supply pipes would be buried deep enough in the ground not to freeze up or interfere with tending the soil. To these buried mains could be connected vertical pipes and a long rubber hose could be connected to these vertical pipes, which would be placed one to each acre. In operation, the farmer could attach the hose and water one acre at a time, until his whole corn, wheat or hay crop had been sufficiently provided with moisture.

We Know That It Is Impracticable for Farmers to Water Their Crops by Running Sprinkler Pipes Over the Fields, as These Would Interfere With the Cultivation of the Ground, such as Plowing, Etc., but Says Mr. Hobson, Why Would it Not be a Good Idea to Place the Necessary Water Pipes Under Ground, and to Provide at Suitable Intervals Short Pipes and Valves Projecting Above the Ground for the Attachment of a Hose?

On first thought this idea may sound peculiar, but I am sure that the average farmer would rather trouble himself a little with keeping his crops from burning up from the drought, than to sit by as helpless as a mouse and see his profits go up in heat. At any rate the modern farmer would appreciate a practical system of this kind, and if I am not badly mistaken, we will live to see the day when our important crops will be independent of such substance that may or may not come from the sky.

PHONE TRANSMITTER SILENCER

When talking over the phone to a customer or others and you find it necessary to ask someone in your office about the subject of conversation, and you do not wish said customer to hear your inquiry, you automatically and naturally place the palm of your hand over the mouth-piece to prevent any of your diverse conversation from entering the phone.

But why not invent a small lid or cover to take the place of the hand over the transmitter? A small felt covered metal disc could be held movably over the mouth-piece by a spring, and could be pushed back from the opening during conversation. Or an arrangement could be designed to hang the receiver on that would close the disc over the transmitter when the weight of the receiver pulled downward on it.

Undoubtedly there would be a ready and wide sale for an improvement of this kind.

How Many Times Have You Wished That You Could Eliminate That Infernal Noise in Your Telephone Receiver, Especially on Long Distance Calls, Which Noises are Very Frequently Caused by Local Conditions, Ordinary Sounds Being Picked Up by Your Microphone, so That You Have to Place the Mouthpiece Against Your Face in Order to Keep the Receiver Quiet? Why Not Provide a Spring Controlled Flap Which Would Cover the Mouthpiece Except When Talking Into It?

SOAP TABLETS

People who do considerable traveling will appreciate this improvement as one of the greatest necessities. Every hotel provides their guests with soap, but the maids often fail to replace a used bar with a new one, and having to use soap, that some other person rubbed over their possibly-diseased skin, is not a very comfortable feeling.

Now it has often occurred to me that soap of good quality could be packed in convenient sized tablets that could be used one or two at a time, as desired. Small tablets of soap could then be easily carried along on the trip, and individual cleanliness would be assured. An attractive trade mark and package, a good quality of soap, then some well directed advertising, should soon create a large, profitable market for an article of this description.

Soap-Tablets Would Seem to Present a Very Fine Field for Development, Especially for the Traveling and Hotel-Living Public. It is Not the Most Sanitary or Desirable Method to Have Soap in One Large Cake Which Gathers Dirt, Et Cetera. If You Could Have Fresh Soap Each Time, What a Treat!

Questions for Young Scientists

This winter's crop of freshman boys and girls in a leading American High School was given a series of questions that tested their knowledge of everyday science and perhaps their sense of humor at the same time. The young scientists were asked to check the answers to the various questions that they thought correct. The wrong answers were the "howlers" of former students. The "test" was in part as follows:

You do not hear thunder until some time after you have seen the lightning because—

(a) The lightning is closer to the earth.

(b) The thunder is miles away from the lightning.

A mountain top is colder than a valley because—

(a) It is nearer to the sun.

(b) It receives less heat from the sun.

Dark colored clothes are worn in the winter and light colored clothes are worn in the summer because—

(a) The dye in black makes it warmer.

(b) Dark colors fade in summer.

(c) Dark absorbs heat and light throws it off.

(d) Light clothes get soiled more easily in winter.

When a street car stops suddenly the passengers lurch forward. When it starts suddenly they are thrown backward because—

(a) It is so sudden they do not expect it.

(b) A vacuum is formed in front of or back of the car.

(c) The car moves and stops and their bodies do not.

You can see your breath on a cold day because—

(a) Water vapor in your breath condenses when cooled.

(*Continued on page* 661)

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LATEST PATENTS

Sound Reproducing Apparatus

(No. 1,383,271 issued to William MacDonald Smith)

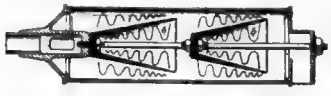
The inventor of this system tries to do away with the harsh sound emitted by a phonograph, and has discovered that a tube of jelly has the property

of allowing free passage and reinforcement of regular vibrations, such as musical tones, but not the irregular vibrations (noise). One convenient way of mounting the jelly consists in enclosing the jelly-like mass in a casing secured in the sound box. The jelly mass is then heated to cause it to adhere to the diafram. A thin slot is cut into this jelly mass so as to leave a very thin part of the mass on each side of the slot or slit. By transmitting the music thru this jelly mass, it is claimed the sound is considerably purified, only the regular vibrations passing thru.

Engine Exhaust Sound Modifier

(No. 1,384,964 Issued to Herbert Leggett)

A device for modifying the harsh sound of exhaust gases from an internal combustion engine and converting this into harmonious tones, consists of a tubular shell closed at both ends with a flange and connected to the exhaust pipe of a gas engine. As the exhaust gases pass thru the annular passage way they impinge against the conical walls of the sound modifier, which



walls direct the gases to a restricted annular passage-way between the mouth of said modifier and the shell. After passing thru the passageway, the exhaust gases escape to the atmosphere by the outlet duct. The sound modifier is placed in a position abutting against the closed end of the duct. These modifiers are conical in form and are fastened at their smaller ends, while their mouths are free to vibrate, and this tendency is increased by the tapering of the metal; they are of the peculiar form shown in the diagram, and there are several of them arranged within the tubular shell. It is claimed that the device causes sufficient change so as to give harmonious sound instead of the usual noise which the exhaust gas gives.

Aerial Torpedo

(No. 1,384,559 Issued to Lloyd Giles and Sidney H. Woodruff)

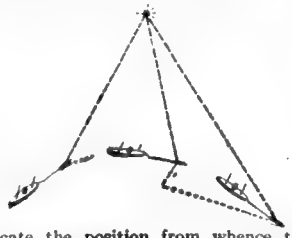
We see here an interesting aerial torpedo, which is designed to carry explosives for great distances over the enemy's lines. The entire device is

very similar to a regular airplane except that no pilot flies with it, the controls being automatically maintained and changed by pre-determined clock-work arrangement. Back of the engine is a heavy charge of some very high explosive which detonates when the machine finally plunges earthward. The controls consist of a number of solenoids which are actuated by pendulums, a tipping of the machine in either direction being sufficient to close the circuits of the solenoids. These solenoids in turn open and close respective valves for the operation of pistons which are connected to the ailerons and elevating rudders. A gyroscopic arrangement keeps the machine upon the predetermined course. In operation the elevating rudders are so arranged that the machine will rise upward. A clock-work device is so arranged that it has no effect upon the elevating rudders until the machine reaches the desired height; then the clock-work control switch is opened and thereafter the machine depends upon the pendulum-controlled switch for keeping it on an even keel. When it has traveled the determined distance, the clock-work sets the controls so that the torpedo turns its nose toward the ground. In another form the machine releases aerial torpedoes and then returns again to the station which sent it out.

Detecting Under Water Vibrations

(No. 1,383,690 Issued to Harold D. Arnold)

With this device it becomes possible to detect under-water vibration and

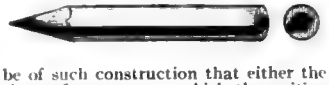


locate the position from whence the sounds emanate. In the proposed method a towing device or "fish" is drawn by the vessel by means of a cable thru which the wires for the listening apparatus pass. Two microphonic detectors are located within this towing device, and these microphones connect in series with batteries to the apparatus on board ship, which comprises a telephone receiver, and a stethoscopic ear-tube. The sound from one receiver will affect one ear and the sound from the other receiver the other ear. Adjustable circular tubes enable the distance between the receiver and the stethoscopic tube to be varied, and when the sound in both ears is identical, a reading of the scale is taken. In this manner it is possible to locate the distant object or sound emanating source by geometrically plotting the angles from the scale readings. Two or three readings may be taken if necessary as the ship proceeds on her course.

Luminous Pencil

(No. 1,384,706 Issued to Walter Meyner)

The inventor of this device has attempted to make a pencil which will

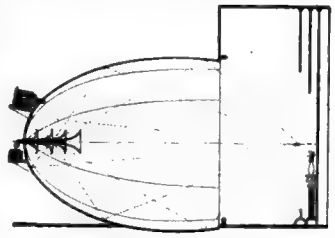


be of such construction that either the sheet of paper upon which the writing is done will be illuminated by the pencil itself, or the writing will be luminous. The bore of the pencil communicates directly with a longitudinal slot of slightly smaller dimensions than the central bore itself. The writing material is preferably composed of a body, such as is employed in the so-called radium paints, impregnated with grafite or some other pigment. If desired, the writing material may be made up of this self-luminous substance, containing a sufficient proportion of an oily substance to keep the same soft. In the latter case, the writing may also be read in the dark.

Apparatus for Recording Sound in Motion

(No. 1,384,612 issued to Robert D. Gray)

The inventor here attempts to produce a motion picture film in exact

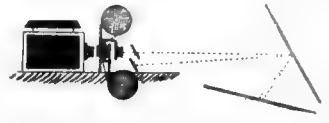


synchronism with the sound record. For this purpose he provides for a reflector capable of picking up sounds, and which reflector has many curved surfaces which have one focus at approximately the same point within the reflector, and secondary focuses at different points upon the stage, thus enabling the actor or the actors to move over a considerable area in the neighborhood of common focus points. The apparatus in its general construction comprises a stage, a sound reflector in front of the stage and a receiver located at the acoustic focus. A motion picture camera is arranged outside the sound reflector, which reflector is made up in the form of a large number of segments. In this manner different parts of the stage are brought into focal point with regard to the receiver.

Stereoscopic Projecting Apparatus

(No. 1,383,538 Issued to Herbert Dickinson and George A. W. Hepburn)

There have been several ways devised for obtaining a stereoscopic effect from motion pictures. Some of these depend upon photographing the objects against a black background, and

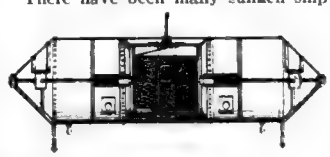


then projecting them upon a scene furnished by a slide in an ordinary projecting lantern. In other cases two pictures are arranged side by side on the film. With this invention, however, the ordinary film may be used. This is projected thru a partial reflector, as, for instance, a sheet of plate glass. Most of the image will be thrown upon the screen, but a portion of it will be reflected on to a secondary reflector and thence upon the screen. The images are so arranged that they are slightly out of register, which effect is obtained by adjusting the angle of the reflector. This produces the stereoscopic effect. An inclined reflector may also be used to project the images upon a second screen, as shown in the illustration.

Sunken Ship Indicating and Safety Device

(No. 1,384,736 Issued to Joseph Ardo and Oscar Phillips)

There have been many sunken ship

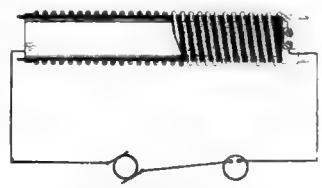


indicating devices which have attracted our attention from time to time. Here is one, however, which is of improved form. It consists of a cylindrical casing provided with conical ends, which forms the float. Within this casing is located a drum on which is wound a rope attached in turn to the deck of the ship. The drum is constructed so as to be collapsible. The rope is firmly attached to the deck of the ship and the float properly placed is held in suitable supports. If the ship sinks, the rope uncoils rotating the shaft at the same time. This shaft drives an air-compressor, which causes whistles to sound for a considerable time after the rope has ceased unwinding. The crew having entered the device thru the doors will find that their compartment increases in size as the drum walls collapse.

Means for Detecting or Measuring Moisture

(No. 1,383,233 Issued to Charles A. Parsons and Alexander H. Law)

Sometimes it is necessary to cool large turbo-generators with great quantities of air and it is customary to cool this air with water sprays. In order to detect whether any moisture remains present, the inventors have devised a testing coil, which is composed of a

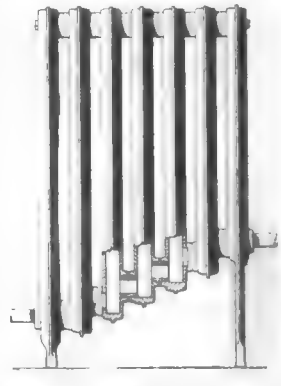


metal tube around which a piece of insulating material is placed such as leatheroid, and outside of this a coil of metal wire is wound. The entire apparatus is suspended in the air-ducts between the water filter and the turbo-generators and by connecting it in series with an indicating instrument, such as an ohmmeter, the amount of moisture is easily determined.

Improved Noiseless Radiator

(No. 1,384,606 Issued to William J. Farrell)

In heating-radiators, such as are ordinarily employed in steam heating plants, very objectionable knocking



noises are sometimes heard. This is commonly known as a water hammer, and it is due to a condensation of water at the bottom of the radiator, which cannot be drained away fast enough. With this particular device the inventor claims to have eliminated this objectionable sound. The radiator itself is made up of a plurality of sections, each of which is shorter than its preceding one, and the outlet, opening on one side of each section adjacent to the bottom, is at a higher level than the opening on the other side of said section, whereby the radiator may be easily and quickly drained and water-hammer effectually prevented.

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My Big Announcement this season—

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But These Men Never Had the Opportunity You Have Right Now

The railroad fare to Kansas City is a big item. Lots had to pinch and scrape to make it. **But I will now pay your fare.**

But, you must COME NOW. I don't know how long I will keep this offer good. Because I WON'T ACCEPT MORE MEN than I can properly handle and give the attention to them that the *Sweeney System* demands. I've got over a quarter million dollars' worth of equipment in the largest trade school in the world, covering 12 acres of floor space—but there's a limit to all things. And when that limit is reached—I'll withdraw this Free Fare Offer.

Business Is Better!

Young man, be Independent. Strike out for yourself. Hold up your head. On the skyline of Opportunity see the Sweeney School. We are TRAINERS OF MEN, ARCHITECTS of SUCCESS. I have made a million dollars in fifteen years BY MAKING OTHERS SUCCESSFUL. Take your first step towards success by writing me today. Over 46,000 successful graduates.

SWEENEY trained men are in demand everywhere at good wages, **$50 a week and more,** from garages, tire shops, welding concerns, auto repair shops, etc. In the last six months farm products have all gone down, *but the autos still kept running and no trained mechanic had to hunt a job.* Top wages are paid but Sweeney trained men are wanted. Here's proof:

Hundreds of Openings For Men!

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The Oracle

(*Continued from page 636*)

about 20 per cent overload before the fuse melts.

Q. 3. Does a given size fuse wire always melt at the rated current?

A. 3. The fusing current is liable to vary 50 or even 100 per cent, according to circumstances. The temperature of the surrounding air or other substances affects the melting current greatly, for the melting temperature is about constant, while the rate at which heat from the fuse will be transferred to the surroundings, depends upon the difference of temperature between them and the fuse; consequently, a fuse in a warm place will be melted by a smaller current than a similar fuse in a cold place.

Professor George D. Shepardson in his book, *Electrical Catechism*, describes the action of fuses at length, and the table of fusing currents for different wires given below from his work, will be found most useful:

B. & S. Gage No.	Diameter in Inches	Fusing Current in Amperes: Copper	Lead	Solder Alloy ½ Lead and ½ Tin
36	.005	4	..	..
34	.006	5	..	..
32	.008	8	1	1
30	.010	11	..	..
28	.013	14	2	2
26	.016	20	3	..
24	.020	30	4	3
22	.025	42	7	5
20	.032	60	10	7
19	.036	70	11	9
18	.040	83	13	11
17	.045	100	15	13
16	.051	120	17	15
15	.057	140	20	18
14	.064	166	22	20
13	.072	200	27	24
12	.081	235	33	30
11	.091	280	38	35
10	.101	335	44	41
9	.114	390	51	48
8	.129	450	62	58
7	.144	520	77	73

When the wires are open to the air and when long enough so that the cooling effect of the terminals does not extend to the middle of the wires (the fuse wires being from 2 inches to 12 inches in length, according to their diameters), the currents required for melting are approximately as indicated in the above table for copper, lead and solder alloy wires.

Queries on Magnetism

(1163) James McEllroy, Cincinnati, Ohio, inquires of this Department:

Q. 1. Does a steel horseshoe magnet retain its magnetism longer, if its steel or iron keeper is left in contact with the north and south poles, when the magnet is not being used for experiments?

A. 1. A permanent steel magnet will always retain its magnetism much longer if the iron or steel keeper is left across the poles when the magnet is not being used, as otherwise the magnetic lines of force may be reduced and permanently diminished by the earth's field; also the lines of force have to complete their circuit from the north to the south pole thru the air, which offers a very high resistance to them; factor is called by engineers "the magnetic reluctance of the circuit."

You will be surprised to note that a soft iron ring retains magnetism for quite a long period of time after it is magnetized in one way or another, but as soon as a section of the ring is removed, the magnetism will rapidly decrease to almost zero, as soft iron has about the poorest retentivity of any of the ferro-magnetic substances. If you happen to possess an electro-magnet of any size, large or small, you can readily try this interesting experiment by placing a piece of iron across the poles, and when the circuit is opened you will find that a relatively strong pressure will have to be exerted on the armature to pull it from the magnet poles. But once you have pulled the armature away from the pole faces, you will usually find that there is not sufficient residual magnetism left in the soft iron cores and yoke of the magnet to even hold the armature in place.

Q. 2. From what I have read concerning the operating principle of so-called oil, water and ore locaters, it would seem that some of these instruments, according to their inventor's claims, depend upon some variation in the earth's magnetic field, due to the presence of such quantities. Is this true or not?

A. 2. Inventors of instruments intended for locating ore as well as underground oil and water, have made such statements it is true, and possibly in all seriousness, but the scientists of today look into such problems pretty thoroly and in referring to a publication of the U. S. Geological Survey, we find it stated most emphatically, that there is practically no reason, at least at the present time, for placing any faith in such instruments; as thousands of measurements and tests made in all parts of the world have shown no evidence for believing in any such phenomena.

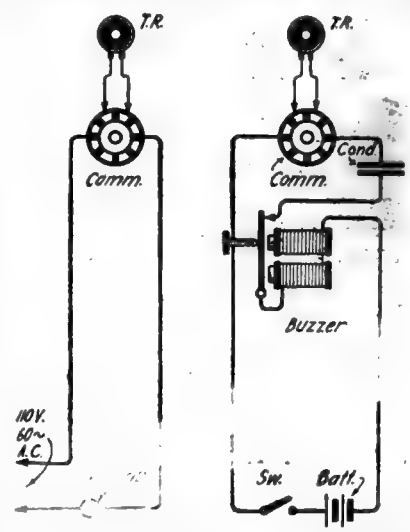
In plain language, the publication referred to states therefore that the presence of any non-magnetic metals such as silver, gold, copper, platinum, etc., or the presence of underground oil or water, will not make their presence known by a measurable variation of the earth's magnetic field at that point. If such were the case, prospectors and mining engineers would be very fortunate indeed, for then an instrument which would measure accurately slight changes in the earth's magnetic field could be calibrated, after a careful series of tests, so as to indicate the presence of these different metals or liquids.

Magnetic iron-ore or other ferro-magnetic metals can be located by means of the dip compass, a magnetized and delicately pivoted steel needle, owing to the extra pull or declination exerted on such a needle when it is placed over such a deposit, even if the ore is located deep in the ground, but as the U. S. Geological Survey points out, even this indication requires considerable skill and judgment on the part of the user to interpret the indications obtained. It should be remembered also in this connection that there are in various parts of the world, and in fact everywhere, frequent variations in the earth's magnetic field caused by reasons not very well known at present, but variations nevertheless, and these frequently are so pronounced as to upset the interpretation of the dip compass readings.

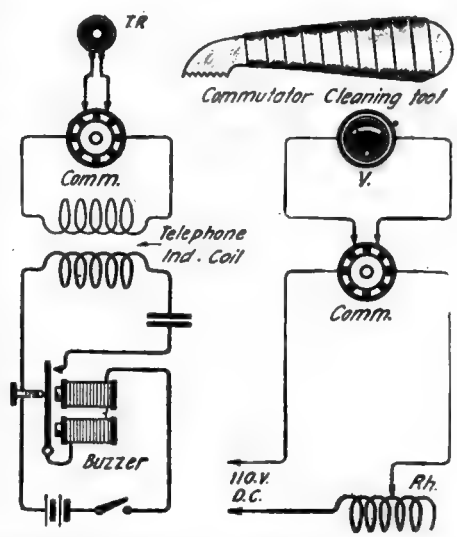
Testing Armature Coils

(1164) Richard R. Smith, Ithaca, Mich., asks:

Q. 1. Upon looking thru the Oracle of the May, 1919, *Electrical Experimenter*, I saw an article



Testing Armatures for Opens and Shorts With Two Different Methods: Left—A. C. Series Lamp Test With Telephone Receiver; Right—Buzzer and 'Phone Test.



Left—Using Induction Coil With Buzzer Test. Right—Testing Drop of Potential Across Armature Coils to Locate Opens and Shorts.

which states that a test for open and short-circuited armature coils can be made by the use of a buzzer and a 75 ohm telephone receiver.

I would be pleased to have you give diagram showing proper connections.

A. 1. We offer the following information you desire concerning a telephone test on armatures for open and short-circuited coils.

Diagram herewith shows several ways of connecting a buzzer to brushes; the telephone receiver test leads are placed across adjacent segments all the way around the commutator, turning the armature slowly until all of the coils have been tested.

(*Continued on page 643*)

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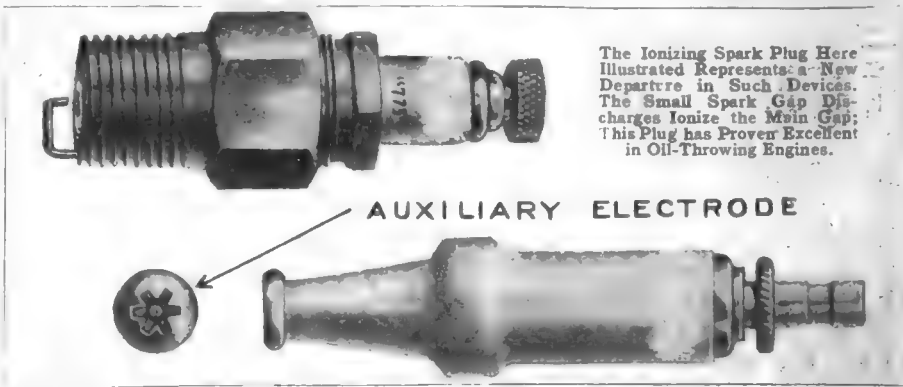
New Ionizing Spark Plug

Science has at least had a hand in the design of this latest addition to the ever growing spark plug family. The design of spark plugs has for some reason or other been carried out in a haphazard manner, as it would seem from the vast number of designs now available on the market, but the electrical and radio engineer have seemingly had very little to do with these devices, which certainly come within the scope of their particular knowledge of the subject. The spark plug here illustrated has been tried by one of the editors, and is certainly one of the most excellent he has ever used, particularly as this plug has shown remarkable firing qualities in an oil-throwing automobile engine, which is one of the hardest conditions met with in practice.



The Ionizing Spark Plug Here Illustrated Represents a New Departure in Such Devices. The Small Spark Gap Discharges Ionize the Main Gap; This Plug has Proven Excellent in Oil-Throwing Engines.

The secret of the efficiency of this new spark plug lies in the fact that it has a metal cap or auxiliary sparking ring fitted on the end of a solid porcelain member, and due to the heating of this ring and to the peculiar design of the porcelain, it is difficult for carbon to collect and lodge on the plug and foul it. But this is only a minor consideration, the chief point being that this auxiliary metal ring acts like a condenser and takes on an electrostatic charge, due to its close proximity to the outer metal shell of the plug, which is a part of the circuit. Because of this ring taking on a charge at each spark, an auxiliary discharge of small sparks takes place between the auxiliary electrode ring and the center electrode, in advance of the main gap discharge.

This auxiliary discharge, altho quite small and hardly visible to the naked eye, will produce ionization of the gas or air in the main gap of the plug, thereby increasing the number of ions present there. Due to the action of these ions a discharge in the main gap will be affected at a considerably lower voltage or electrical pressure than that required by the ordinary plug. This action is also enhanced by the ultra-violet radiation from the small gap, which will enable the discharge to jump the large gap, on the principle of Lodge's sympathetic spark gaps. Following out this and other electrical considerations, it has been proven in a test made at the U. S. Bureau of Standards laboratories, that this plug will accomplish what its makers claim—viz., fire with a considerably less voltage than the ordinary plug, and also much faster than a plug of the ordinary type, which is subject to a considerable lag of the discharge. This plug is said by its makers to be the fastest firing plug every built. A test made in one of the automobile engine laboratories at the Milwaukee School of Engineering demonstrated, that this particular spark plug could stand up and fire regularly in an oil-throwing engine, for a time period forty-five times longer than was shown by any other plug tested at that laboratory. It is interesting to note in looking over the U. S. Bureau of Standards test report on this plug, that it required 63 per cent more voltage to fire a spark plug of the usual construction than it did the ionizing plug of the design here shown.

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GETTING MORE EGGS BY ARTIFICIAL LIGHT

For several years this has been a subject of interest to poultrymen, grocers, lamp merchants, and the consumer. That hens will lay more eggs during the winter if given a longer working day, and additional food, is an establisht fact. Mr. Willard C. Thompson, New Jersey Experiment Station, writes in *The Rural New Yorker* to the effect that artificial illumination properly used will practically double winter egg production, which, as a rule, means doubling the profits. Artificial lighting may not increase the number of eggs produced during the year, but it induces greater production during the period of highest prices, which more than offsets any loss of production during the summer when prices are relatively low.

Experiments with lighted and unlighted hen houses show the following results from 50 April hatched pullets in lighted houses and 50 April hatched pullets in unlighted houses during October, 1919.

Eggs Laid During Week Beginning	Oct. 6	Oct. 13	Oct. 20	Oct. 27	Total
Lighted ..	53	150	211	250	664
Unlighted ..	17	74	130	174	392

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What the Old Timer said to Charley

by C.L.Hardy

"ONLY a few years ago, Charley, the man whose name you see on that door was just where you are today.

"I remember the day he came to work for us. He didn't know much about the business. But he was always asking questions—always anxious to learn.

"And by and by we got to noticing that Billy Stevens was getting ahead of some of us old fellows who had been around here for years.

"I can remember as clearly as though it were yesterday, the day Billy showed old Tom Harvey how to figure out the pitch of some new bevel gears we were making on an important contract.

"Tom told me afterward how respectful Billy was—nothing fresh, or 'I know it all' about him. He just made a suggestion and showed Tom a quicker way to start the problem and a shorter, surer way to finish it.

"One day I said to him—'Where'd you get hep to all that fancy figuring, Bill?' We were eating lunch and he was reading some little book he always carried. He looked up at me and said innocently: 'Oh, I just picked it up!' I knew different than that, so I quizzed him until he told me the whole story.

" 'Did you ever notice the old men around the shop,' he asked—'the men with families who drudge along day in and day out—never getting anywhere?' I admitted that I had noticed quite a lot of them.

" 'Well,' he said 'I made up my mind I wasn't going to spend my whole life in a humdrum job at small wages. So I took a home-study course with the International Correspondence Schools that would give me special training for this business.

" 'I tell you frankly that I never dreamed it would be so fascinating and so helpful in my work. I'm making mighty good money—twice as much as formerly—and I'm going to have even a bigger job around here some day.'

"Well, Charley, that boy went straight on up. The members of the firm heard about his studying in his spare time and encouraged him to keep on. You see where he is today.

"And I—I'm still plugging along at the same old job—struggling to make both ends meet. I had just as good a chance as Billy Stevens, but I let it slip by. Yes, I let it slip by.

"Now, Charley, you've got to want your training bad enough to get it. That's as far as I can help you; you've got to do the rest yourself.

"I've seen a lot of young men come into this business. Those who went ahead were always those who trained themselves for the job ahead. You can do the same thing.

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☐ STATIONARY ENGR.
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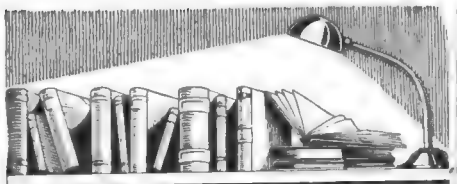

BOOK REVIEW

PRIESTLEY IN AMERICA—1794-1804. By Edgar F. Smith. Cloth covers, size 4¾″ by 7¼″, 173 pages. Publisht by P. Blakiston's Son & Co., Philadelphia, Pa.

The rivalry between English and French in the matter of discovery of oxygen has the faculty of bringing the names of Priestley and Lavoisier very much to the front. Both of them lived in the days of the French revolution. Lavoisier was guillotined during the "Reign of Terror," and Priestley, who was decidedly radical, probably had a tendency to the other side, that of the Jacobins.

To those interested in the early history of chemistry, this book will naturally be of great interest,—to the American particularly in its references to William Cobbet, Benjamin Franklin and others in this country. The specimens of the literature of the day show that the most rabid of the utterances of the present day radicals are very mild compared to the polemics of the 18th century. It is full of human nature and just because of the many quotations from contemporaneous authorities, makes excellent reading.

It was on August 1, 1874, that the centennial of the discovery of oxygen was celebrated by a group of chemists in Northumberland in Pennsylvania at Priestley's dwelling house, and this is taken as the origin of the American Chemical Society which has gained such prominence in the scientific life of America.

CATALYSIS AND ITS INDUSTRIAL APPLICATIONS. By E. Jobling, M.C. Second Edition. 12 illustrations. Cloth covers, size 5″ by 7½″, 144 pages. Publisht by P. Blakiston's Son & Co., Philadelphia, Pa.

When one opens this book and glances over the contents, it at once appears that this should absolutely be read by all of us. It is impossible to fully realize the importance of catalysis.

It is difficult to believe that a manufacturers' low price substance, such as sulphuric acid, and one which is produced in vast tonnage, can be made by utilization of the catalytic action of the expensive platinum, but this is only one instance of it. Nitrogen and its different compounds give excellent examples of it.

The fifth chapter is devoted to surface combustion, incandescent gas illumination and the production of hydrogen, and the purification of coal gas,—and while it might be very much longer,—it is certainly suggestive and interesting.

Like many of the Blakiston books which we have recently reviewed, excellent references to books follow the chapters so that the work is not only a readable one, but is a guide to very extensive study,—or when one is interested in a certain branch of catalytic chemistry by selecting the proper page, one will have an excellent readers' guide.

DICTIONARY OF EXPLOSIVES. By Arthur Marshall, A.C.G.I., F.I.C., F.C.S. Cloth covers, size 5½″ by 8½″, 159 pages. Publisht by P. Blakiston's Son & Co., Philadelphia, Pa.

The title of this book tells what it is, and the best encomium which we can present, is to say that it lives up to its name. We find it is alphabetically arranged, with very clear type, and describing the deadly explosives, which unfortunately caused the loss of so many lives during the six years of the World War, which has seen the misuse of explosives in the destruction of life and property, and in the accumulation of international debts.

At the beginning of the book is given a classification of explosives, under such headings as coal mining explosives, blasting explosives, high explosives, etc. Here the dictionary portion of the book begins and upwards of 100 pages are devoted to the presentation of this subject. Then comes an index of constituents, alphabetically arranged.

Each constituent is followed by a list of explosives into which it enters. T.N.T. or trinitro-toluene figures as a constituent of some two pages of titles.

The book is reasonably complete, altho we do find, as far as we have been able to ascertain, at least one omission.

It is curious to note that nearly half the explosives in this book are coal mine explosives. It is hoped in the future that the number will be reduced by the process of eliminating the less available ones.

A TREATISE ON AIRSCREWS. By Whyrill E. Park, A.R.C.Sc. Profusely illustrated. Cloth covers, size 5¾″ by 8¾″, 308 pages. Publisht by the E. P. Dutton Co., New York.

This very elaborate book is devoted to the practise and mathematics of air propellers such as used on airplanes. A more scientific and better worked out theory of their operation has long been needed,

(Continued on page 644)

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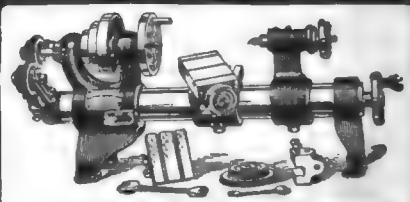

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The Oracle

(*Continued from page 638*)

When a coil is normal as to its resistance and continuity, a steady hum will be heard in the 'phone and this same note will be heard for each normal coil when the test leads bridge two adjacent segments. An open-circuited coil will make its presence known by a loud noise in the 'phone, while a short-circuit or partial short-circuit will result in either no sound, or else a reduction of the sound in the 'phone.

In actual shop tests the two leads supplying the test current from the buzzer or else current from a 110 volt A. C. circuit with a 110 volt lamp in series, are tied in position on the commutator at the points normally occupied by the brushes. A string passing several times around the commutator will hold the leads firmly in place and they can be shifted easily from time to time as fast as one-quarter or one-half of the armature is tested out with the 'phone.

Another common shop test is to pass D. C. th. a rheostat or lamp bank and then thru the armature by tying the test leads in the position normally occupied by the brushes, and using either a low-reading voltmeter or else shunt ammeter from which the shunt has been removed, for testing the difference of potential across any two commutator segments.

This is known as the "bar to bar" test. An open circuit in the coil is indicated by a high deflection, while a sub-normal deflection denotes the presence of a short-circuit or a partial short. Frequently it will be found that the copper segments are short-circuited by a thin thread of copper due to the commutator having been turned in a lathe, etc., which can be picked out from between the segments with a pen knife or a pointed tool made from a piece of old hack-saw blade, as shown in the sketch.

Guided Airplane Makes 150 Miles an Hour

(*Continued from page 610*)

western parts of the United States, is the fact that these aerial railway cars will operate best at a considerable height above the ground, with plenty of free air, and it is proposed to build the steel towers of 300 to 400 ft. high. This may sound somewhat extreme, all things considered, but it is not so unusual, when one has seen the gigantic wireless towers erected by the Radio Corporation of America at its stations, both at New Brunswick, N. J., and on Long Island, where the new Radio Central station is rapidly nearing completion. The steel latticed towers erected at the new station on Long Island serve as a very good example, to show us about what will be required, and also what can be done in the line of accepted mechanical engineering principles at the present day. The steel latticed towers erected at the Radio Central station at Rocky Point, Long Island, stand 400 ft. high, have a base about 60 ft. square, and at the top of the tower a latticed girder is mounted measuring 150 ft. in length and weighing 8 tons. These towers, of which there are 12, spread over a line of approximately 3 miles, and are spaced 1,250 ft. apart. The engineers' figures show that the towers as built, are designed to carry a horizontal load at the top of 30,000 pounds, or 15 tons.

Traveling at the rate of 150 miles an hour, such a guided aerial car or train, would cover the distance between New York and Chicago in approximately 6 hours, or would travel across the continent from New York to San Francisco in a little more than 20 hours, if the aerial lines could be laid out in a nearly straight line between the two coasts.

PIGEON FLIES FROM CHICAGO TO WASHINGTON IN 16 HOURS

A pigeon which carried a message from Mayor Thompson of Chicago to President Harding in sixteen hours actual flying time for the 614½ miles broke a world's record, the Department of Agriculture announced on Aug. 29th.

The bird was a product of the Government's loft at Beltsville, Md.

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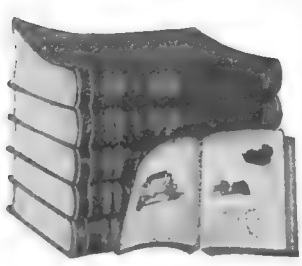

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Book Review

(*Continued from page 642*)

and it is a very welcome thing indeed to find a book now upon the market which will do for us this very work. The subject of this book is mathematically treated. While this is perfectly true, the practical part of the subject receives adequate consideration, such as the comparison of woods used for airplane propellers, etc.

The practical aspect of the book appears too in the section devoted to the work of the draftsman and as done on the drawing board. This is very exhaustively treated. Laminations and miscellaneous propellers of which there are many, are also treated. Even the different glues, including casein cements, are given space in the text.

One interesting point, recommending that the laminations of the propellers should not be clampt for five minutes after the application of the glue in order to allow it time to enter the pores of the board, is to be noted. This would seem to apply to all glueing operations.

Hand- and machine-working of the laminated blocks and special methods of construction are given and at the end of the book a number of appendices make really interesting reading, and a good index follows the text.

PRINCIPLES AND PRACTICE OF AERIAL NAVIGATION. By Lieut. J. E. Dumbleton. Cloth covers, size 5½ by 8". 172 pages. Profusely illustrated. Publisht by the D. Van Nostrand Co., New York.

This very interesting book treats of the peculiar problems that have arisen with the development of aviation. For many generations one of the world's unanswered problems was the determination of the latitude at sea. It ranked practically with the squaring of the circle and with the trisection of the angle. Eventually it was solved by the production of an accurate time piece, the chronometer. The chronometer is now, to a certain extent, supersedable and perhaps eventually to be superseded by radio direction of ships in aerial navigation. The use of the textant for airplane navigation is practically barred, on account of the bad horizon obtainable at flying heights, as well as because the height of the plane is not accurately known.

The book, therefore, perforce is devoted to a considerable extent to dead reckoning and to the practical details of finding the way in the air. To anybody interested in the problems of navigation, the book will form excellent reading. It is liberally illustrated and would seem to be an indispensable manual for long distance airplane work.

CITY OF ENDLESS NIGHT. By Milo Hastings. Size 7½ x 5", 346 pages. Dodd Meade & Co., New York City.

A romance of Germany centuries hence. Mr. Hastings has written a marvelously interesting book that cannot fail to interest the technically inclined. He shows to what German ruthlessness and German science has brought the Germany of the distant future. Finding itself in an antagonistic world, the German nation has dug itself into the subterranean city of Berlin, which has some sixty or seventy levels, in which dwell the 300,000,000 Germans. Everything is pure science. The populace lives on synthetic food, synthetic clothes, synthetic everything. Eugenics has been driven to the nth degree. No such thing as family life exists any longer in this ultra-Berlin. Everything is militaristic and well ordered. The citizens do exactly as they are told by their superiors. This entire nation is governed by one, William III, of the Hohenzollerns, who considers himself and God as kin.

There is nothing impossible in this book, which shows what science directed into certain channels may do. An interesting book.

CONNECTING INDUCTION MOTORS. By A. M. Dudley, B. S., 252 pages. Profusely illustrated. Cloth covers, 9¼x6". Publisht by Mc-Graw-Hill Co., Inc., N. Y.

This book is the development of a quantity of material which was originally publisht in the *"Electric Journal."* It was next elaborated into a series of articles, which appeared in *"Power,"* and while the author in his preface is very ready to acknowledge that it may lack unity in some details, it certainly appears to us a most admirable presentation of the winding problem of induction motors. The winding diagrams are numerous and very excellently done from the point of view of clearness and intelligibility, and there are any quantity of these and other diagrams in addition to illustrations, so that the cuts total up to 289 in number. Mathematics as used in its pages are of the simplest order so that none need be frightened with difficult formulas. Wave winding diagrams are given in much detail, and the effect of number of phases upon winding connections is fully elucidated. It has a satisfactory index, and a very excellent feature is an index of diagrams. The book certainly shows a great deal of intelligent work on the part of the author and we gladly commend it to our readers.

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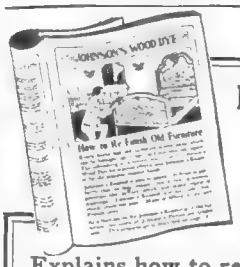

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OUR AIR FORCE. By William Mitchell, Brig. General, U. S. A. 223 pages, fully illustrated. Cloth covers, 8½ x 5¼ inches. Publisht by E. P. Dutton & Co., N. Y.

This very interesting book covers the technique of military aviation in the first twelve chapters. The author, a most distinguished exponent of aerial science, is naturally most interested in its military value and in the possible military achievements of the airplane and balloon. After he has covered the ground on military work in the chapters just specified, he gives a chapter on civil and commercial aviation which, after all, must be regarded as the school for war service; he then speaks of aviation over the sea, with special reference to the destruction of hostile fleets. The general topics of the development of the science, of what the future has in store for it, and of what the United States should do to foster the air fleet of the country, conclude the book. Upwards of forty interesting illustrations are inserted in the text and on the fly leaves, and inside of cover, are printed maps of the proposed airways traversing the United States in all directions. We have one complaint to make, there is no index, and we cannot compliment the book more highly than by saying that it thoroly deserved one.

ELEMENTARY LESSONS. By R. W. Kent. 72 pages. Paper covers 9 x 6 inches. Publisht by Press of the Dunwoody Institute, Minneapolis, Minn.

This is rather an attractive little pamphlet, quite unpretentious and yet satisfactorily covering elementary mathematics, not only such as are restricted to electricity but some more general topics. It is one of those books apparently very elementary, which can be read with benefit by many of us. It is very often that excellent hints are obtained from such books as this, and the possibility of obtaining such hints and this book is very suggestive of such possibility, is a practical tribute to the excellence of the little treatise. We are pleased to recommend it to our readers.

TELEGRAPHY, TELEPHONY & WIRELESS. By J. Poole, A. M. I. E. E., 120 pages. Illustrated. Cloth covers, ers, 7¼ x 4¾ inches. Publisht by Isaac Pitman & Sons, N. Y.

This compact little manual starts at the bottom of things, and before leaving each subject brings it pretty well up to an advanced level. The Pitman firm has publisht a large number of books in this series called the "Common Commodities and Industries Series," and this elementary treatise on account of its merit is such as can be safely recommended to beginners in electrical science. Short as it is, it is furnisht with an excellent index and the long list of books pubisht by Pitman & Sons, while really an advertisement, adds to the value of the book.

POWDERED COAL AS A FUEL. By C. F. Herington. 338 pages. Profusely illustrated. Cloth covers, 9¼ x 6 inches. Publisht by D. Van Nostrand Co., New York.

This is a very elaborate work. Powdered fuel bids fair to assume greater and greater importance in industry, and in this work there are numerous illustrations and very specific descriptions elucidating this subject. The topics are treated in great detail and the advantages of pulverized fuel over combustible in lumps, is strongly brought out. A great many examples and illustrations cover its use as already developed, altho of course the general belief is that its use will extend with time. It is in the line of utilization of culm, which by washing after pulverization, can be made to give a very pure powdered coal. We are even a little surprised not to find the word culm or mine-waste in the index. An excellent point is made that by avoiding excess air in furnace practice, economy is conduced to. We are glad to recommend the book.

MY ELECTRICAL WORKSHOP. By Frank T. Addyman. 249 pages, fully illustrated. Cloth covers, 5½ x 8½ inches. Publisht by The Wireless Press, Ltd., London.

Sometimes the writer of this review has found that English books do not seem to be adapted for the American field of work, but this work altho absolutely English, is one which we can certainly recommend to our readers, and a boy who will go thru it, chapter by chapter, constructing the apparatus as described, will get some very fine classical work in electricity. If he follows the directions, so as to produce nicely made and finished apparatus, his experience in the handling of metals will be of lasting advantage to him. Each chapter is preceded by a list of the materials required to construct the apparatus described in it; a great many illustrations are given, and while it is largely a practical treatise, theory is not neglected, and the

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You spray thousands of volts of vitalizing electricity into any weak organ, tissue or muscle. It stimulates and invigorates without shock, jolt or jar. It immediately draws to the weakened part a vigorous surge of warm, fresh blood that relieves congestion and pain and permanently rebuilds broken-down or sluggish organs.

Violet Ray treatment is fundamental—not merely local. It fills the blood with germ-fighting white corpuscles and increases its oxygen content. It tones up the nerves and muscles as well as the weakened tissues and organs. It promotes the elimination of waste products. It penetrates and saturates the entire body, and tends to normalize and strengthen every nerve, muscle and organ.

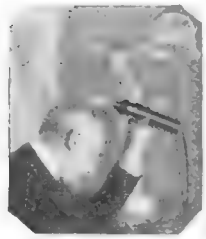
Unequaled in driving out pains and aches.

Treat Yourself At Home

Why pay hundreds of dollars for electrical or Violet Ray treatments in hospitals or sanitariums when you can get these great benefits in your own home, at practically no cost? The Renulife Violet Ray Generator is within reach of everybody, and is sold on the "RENULIFE Fair Trial Plan," giving ample opportunity for you to learn just what it will do for you.

Send for Our FREE Book Now

Giving detailed treatment of more then fifty disorders and telling of the results obtained. Get the opinions, based on personal experience, of scores of RENULIFE users, many of whom report benefits far beyond any claims made by us.



Increases the nutriment in scalp by fresh blood supply, thus promoting hair health and growth.

RENULIFE ELECTRIC CO.
1211 Marquette Bldg.
Detroit, Mich.

In Canada:
Netting Bldg.
Windsor, Ont.

WANTED
Distributors for exclusive sales contract on very attractive basis. Write at once.

Send For Free Book

Renulife Electric Co., 1211 Marquette Bldg., Detroit
Please send without obligation your book "Health for All," explaining Violet Ray treatment with Renulife Generators: also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

..Abscesses	..Falling Hair	..Paralysis
..Anemia	..Female Complaints	..Piles
..Asthma		..Pimples
..Arteriosclerosis	..Goitre	..Pyorrhea
..Baldness	..Gout	..Rheumatism
..Blackheads	..Haemorrhoids	
..Brain Fag	..Hay Fever	..Scars
..Bronchitis	..Infantile Paralysis	..Sciatica
..Bunions		..Skin Disease
..Bruises	..Insomnia	
..Catarrh	..Lameness	..Sore Throat & Throat Disease
..Chilblains	..Locomotor Ataxia	
..Colds	..Lumbago	..Sprains
..Dandruff	..Nervous Affections	
..Deafness and Ear Diseases	..Neuralgia	..Toothach
..Eczema	..Neuritis	..Weak Eye
..Enlarged Prostate	..Obesity	..Wrinkles
..Facial Neuralgia	..Pain in Abdomen and Chest	..Warts an Moles

Name.....

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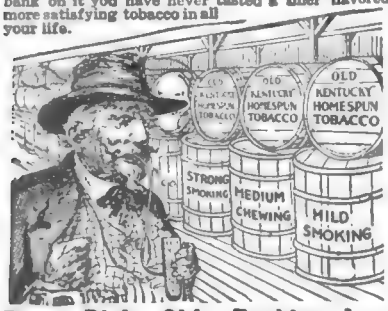
—OLD KENTUCKY—
HOME-SPUN TOBACCO

Direct From Our Farms to You

The Cream of the finest crops Kentucky's bountiful soil can produce—ripe, rich leaves—smooth and mellow—with that **rare** old-fashioned flavor and fragrance that only the proper "aging" can produce. We bank on it you have never tasted a finer flavored, more satisfying tobacco in all your life.



Ripe, Rich, Old - Fashion Leaf

Our Famous Old Kentucky Homespun is no more like manufactured tobacco than day is like night—guaranteed free from chemicals and all other adulterations that conceal imperfections, delude the sense of taste and undermine the health.

Grown and natured in Kentucky's finest soil, cut at the proper time, carefully selected, aged, mellowed, cured and "sweated" by the same method our grandfathers used in preparing tobacco for their own use—**every trace of harshness leaves it — nothing to "bite" your tongue or parch your mouth—nothing to tire your taste.** Mellow as the moonlight—fragrant as the rose. Like old wine from the cellar its rich fragrance permeates the air. Thousands of tobacco lovers the world over swear by its inimitable smoking and chewing qualities.

"For sixteen years I have used almost every brand on the market but yours is the best I ever tasted."
W. E. Swires, St. Marys, Penn.

"Tobacco satisfactory in every way. I now realize how foolish I have been—paying exhorbitant prices of the middlemen instead of buying direct from the growers' association."
C. J. Retzlaff, Motsenno, Wash.

"Say men, your tobacco is the best I have had since 1865 when Abraham Lincoln and I smoked together in the Sunny South. Tell all the old soldiers about it."
John F. Stout, Libby, Mont.

Reduce Your Tobacco Bill 75%

We are growers of tobacco and sell none but our own crops—our co-operative marketing plan eliminates all revenue tax—all middlemen—you deal direct with the growers' association thereby saving 75 per cent or more. No fancy packages, no decorations—just **Quality** and lots of it.

Money Saving Prices

5 lbs. $2.98 — 10 lbs. $5.85
(We Pay All Shipping Charges)

5 pounds will make 65 big sacks of smoking, or 65 chewing or smoking twists. With each order we send complete illustrated instructions showing how to make granulated smoking, old-fashion chewing and smoking twists, cigars, etc.

SEND NO MONEY

Pay only when tobacco arrives. Try it for ten days—if it fails to please you—if it doesn't suit your taste—if for any reason you are dissatisfied send it back and your money will be returned promptly without quibble or question. You **Risk Nothing.** Sign and mail the coupon today and enjoy the tobacco treat of your life.

We Pay All Shipping Charges

Use the Coupon

TOBACCO GROWERS ASSOCIATION OF KY. MAYFIELD, KENTUCKY

TOBACCO GROWERS ASS'N. OF KENTUCKY,
Warehouse 560 **Mayfield, Kentucky**

Send me.....pounds of Old Kentucky Homespun Tobacco by parcel post prepaid. I will pay the price of $.....on arrival. If not satisfied after a 10-DAY TRIAL, I will return the tobacco and you will refund my money.

Name .....

Address .....

Enter below pounds each grade wanted:

SMOKING	—mild	—medium	—strong
CHEWING	—mild	—medium	—strong

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reader will pick up a great deal of the theory of electricity from its pages. There are one hundred and fifty illustrations.

THE VOICE OF SCIENCE IN NINETEENTH CENTURY LITERATURE. By Robert Emmons Rogers. 328 pages. Cloth covers 7½ x 5 inches. Publisht by The Atlantic Monthly Press, Boston.

A very distinguished list of authors figure in the contents of this book, such as Mathew Arnold, Robert Louis Stevenson, Cardinal Newman, and Geo. Meredith. Even the "Rubaiyat of Omar Khayyam" is contained in it, as well as many pages of poetry from Browning, Tennyson, Walt Whitman and others. It is a type of book which can be taken up for half an hour's reading, and while we may not agree with many of the authors in their views and while we may perhaps be sorry that religion is so much brought in, yet none can regret the chapter from "Sesame and Lilies" by John Ruskin. Whatever his eccentricities may have been, he was a great master of the English language.

THE GYROSCOPIC COMPASS. By T. W. Chalmers, B. Sc., A. M. I. Mech. E. Cloth covers, 5½ x 3¼ inches. 167 pages. Fully illustrated.

In the work under review, the new gyroscopic compass, which it is fair to say has thoroly "arrived," is treated of without the use of mathematics, which is certainly a somewhat daring attempt for a gyroscopic investigator. With numerous illustrations, full and clear text, the gyroscopic compass is very well described.

The various compasses of this type which have been put into operation are considered at the end of the book after the entire general principle of the instrument has been elaborately treated.

A suggestion of the difficulty in writing this book is found in the following extract from the preface:

"It is to be remarked that it is much easier to treat the gyroscope and all its practical applications mathematically than non-mathematically." The author, however, has succeeded remarkably well in his popular presentation of the subject.

PRELIMINARY MATHEMATICS. By Prof. F. E. Austin, E. E. Cloth covers. 4¾ x 7¾ inches, 169 pages. Publisht by the author at Hanover, N. H.

This work, within less than 200 pages, covering the elements of arithmetic and algebra, including such things as simultaneous and quadratic equations, logarithms and powers of numbers starting with the very elements of Arabic notations, produces a peculiar impression on the writer until he realizes that it is designed chiefly as a skeleton for use by students desiring to enter college.

To make it more practical, some sample examination papers for different colleges are given. It is one of those books which while purporting to be elementary, is well worth reading by more advanced students, as it is so well done that anyone would be sure to pick up useful items of information from its clearly printed pages. It has an adequate index.

LABORATORY EXPERIMENTS WITH DIRECT CURRENTS. By Prof. F. E. Austin, E. E. Profusely illustrated. Leatherette covers, 4½ x 7½ inches. 152 pages. Publisht by the author at Hanover, N. H.

This other book by Prof. Austin is also a thoroly practical one and the only synopsis of its contents which it is necessary for us to give is to state that it treats adequately the subject of electric measurements:—the Wheatsone bridge and potentiometer, and special tests of cells, coils and electric machinery, including such topics as the commercial efficiency of a machine, the calibration of voltmeters and the same for ammeters. We certainly are glad to recommend it to our readers. It is well illustrated and well indext.

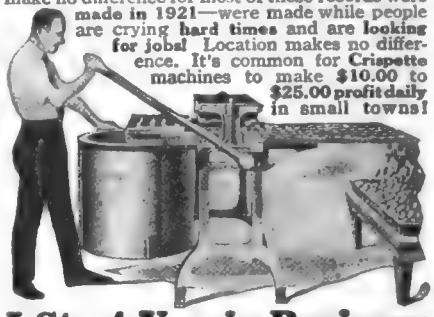
MIRACLE MONGERS AND THEIR METHODS. A Complete Exposé. By Houdini. Fully illustrated. Cloth covers, 5¼ x 8¼ inches. 240 pages. Publisht by the E. P. Dutton Co., New York.

The author of this book is a very well known performing magician, and is certainly by his own experience and extensive acquaintance with the professionals of his class, well qualified to appear as an authority on natural magic. But in addition to this qualification, he is a good writer and in his book he has followed out the history of the science going back to old times and illustrating from old books and describing the feats of past centuries. It makes very interesting reading for those who remember the old times and the days of what was the popular dime-museum, now extinct.

$375.75 ONE DAY

Ira Shook, of Flint, Did That Amount of Business in 1 Day

—making and selling **Popcorn Crispettes** with this machine. He says in letter dated March 1, 1921: "I started out with nothing, now have **$12,000.00** all made from **Crispettes.**" Others have amazing records: Gibbs says: "Sold **$50.00** first night!" Erwin's little boy makes **$35.00** to **$50.00** every Saturday afternoon. Meixner reports **$600.00** business in one day. Kellog writes: "**$700.00** ahead first two weeks." Master's letter says: "—sold $40.00 in four hours." During March, 1921, Turner was offered **$700.00** clear profit above cost of his investment to sell. **There is money**—lots of money—in **Crispettes.** Times make no difference for most of these records were **made in 1921**—were made while people are crying **hard times** and are **looking for jobs!** Location makes no difference. It's common for **Crispette** machines to make **$10.00** to **$25.00 profit daily in small towns!**



I Start You in Business

Write me—get my help. Begin now. Others are making money selling **Crispettes.** You can, too! You don't need much capital. Experience not necessary. I furnish everything—secret formulas, equipment for shop or store, full directions, raw materials, wrappers, etc. Splendid chances galore everywhere! Crowded streets, amusement parks, concessions, wholesaling and stores!

$1000.00 Month Easily Possible

Crispettes are a delicious, delightful confection. People never get enough. Always come for more. Raw materials are plentiful and cheap. You make enormous profits. Trade grows by leaps and bounds. It's an easy, pleasant and fascinating business. Send post card for illustrated book of facts. Contains enthusiastic letters from men and women who have quickly succeeded. Tells how to start. Explains most successful methods. Gives all information needed. It's Free! Write Now! Address

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NO MONEY DOWN Just your name and address brings you the LIZNITE GEM Ring you want. See for yourself the greater brilliance, fire and sparkle of these matchless gems. Examine the hand engraved SOLID GOLD mountings and beautiful, extra heavy rings.

Men's Rings—No. 1, $18.50 — No. 3, $18.50—No. 4, $18.50
Lady's Rings—No. 2, $16.50—No 5, $12.50

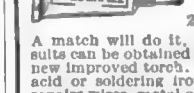
GUARANTEE This ring MUST satisfy you perfectly. Give postman $4.50 when ring arrives. Then wear it 10 days. Your money back if you return it within that time. But if you decide to keep it just send in $3.00 monthly until balance is paid. Include finger size. Offer at this price limited. **ORDER TODAY.**

Dept. 1125 **THE LIZNITE GEM COMPANY**
"The House of Quality and Price" 128 N. Wells St., Chicago

MEND KITCHEN UTENSILS WITH
SOLDERALL
Pat. Oct. 3, 1911

A Paste That Turns Into Metal When Heated. **$1.50**

Our New Improved Torch



25c per Tube

A match will do it, but best results can be obtained by using our new improved torch. Requires no acid or soldering iron. Joins or repairs wires, metal or metalware. Sold by Hardware and Electrical Stores, or sent by us postpaid.

COMBINATION SET Tube and Torch Complete **$1.75**

SOLDERALL CO., Dept. E
129 Sussex Avenue Newark, N. J.

Dealers Send for Prices
Beware of Imitations with Similar Names

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UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TAKING PICTURES OF STARS BY DAY

Photographing stars in broad daylight and lengthening the astronomer's day to twenty-four hours, better photographs taken by airplane cameras and through long-range telescopes, a simple and thoroughly practical method of photography in natural colors that can be used by the amateur as well as by the scientist, effective increase in the power of the largest astronomical telescopes now known, and more knowledge of the color and temperature of the stars will be some of the practical consequences of the improvements that chemists will undoubtedly make in photographic materials in the next few years.

This is the prophecy of Dr. W. F. Meggers, in charge of the spectroscopic laboratory of the Bureau of Standards, which during the war made the photographic plates for aerial use that look through haze and record the landscape that is obscured to the human eye.

"Invisible light waves cause most of the image on the ordinary photographic plate," explains Dr. Meggers. "These are the very short light waves, the ultra-violets and the violets and blues that are on the limit of the visible spectrum. In the early days of photography these were called the actinic or chemical rays because they affect the silver haloid that is used in photographic emulsions. In fact, Dr. R. W. Woods of Johns Hopkins University some years ago showed that if all the visible light is screened out photographs can still be taken with ultra-violet light. The ruby lamp of the dark room can be used because the photographic plate usually used is not red-sensitive."

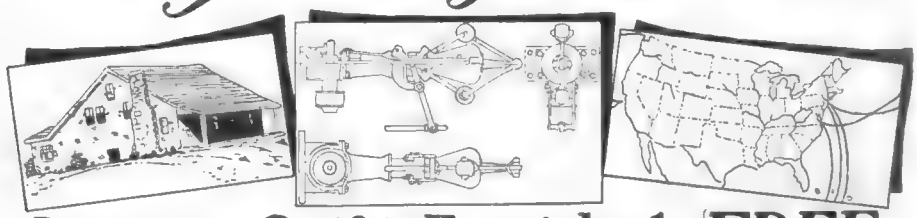
In the last forty years it has been found that if the ordinary photographic plates are treated with solutions of certain dyes they will become sensitive to the visible yellows, greens, reds and even the infra-red waves or the so-called heat waves that are very long. It is this process that is used in making the "panchromatic" plates and other "color-sensitive" plates now on the market.

Before the war Germany had a monopoly of the best of these processes and of the dyes, but during the war two American government research laboratories reproduced and applied all that Germany had ever done and then went a few steps further. The color laboratory of the Bureau of Chemistry of the Department of Agriculture not only synthesized all known photographic dyes but evolved "Kryptocyanin," a new sensitizer for red light, that has made possible plates that have many different applications. The spectroscopy section of the Bureau of Standards used this dye to make plates that could be used in aerial photography during hazy weather.

"The blue of the sky and the red of the sunset and sunrise are due to the scattering of the short wave length blue light," explains Dr. Meggers. Physicists have found that the shorter the wave length the more the light scatters when passing through a turbid medium such as the earth's atmosphere. This happens "inversely as the fourth power of the wave length," as they express it. Haze can be seen through only with difficulty because it scatters the short waves of the sun's light as they travel to earth.

Whether it is the earth obscured from above by haze, a star obscured by daylight or a hazy panorama, the method of red photography is the same. A filter or glass screen that cuts out all the blue or short wave length light is placed in front of the lens. This allows only the red and infra-red rays to penetrate and form an image. Using this method of photographing through haze, pictures taken from two miles above the earth were clean-cut and thoroly distinct.

Easy to Get $35 to $100 a week Making Drawings like these



Drawing Outfit Furnished FREE

You need no artistic talent or "pull." In a few months with our help you can be alongside the best of them, earning enough money to live on and to lay some aside.—Here's how.

Learn Mechanical Drawing

That means Big Money for you, Shorter Hours, Quick Promotion. The real opportunities for success in Mechanical Drawing today are big as compared with other fields. Mechanical Drawing or Drafting is specialized knowledge. It is power to succeed.

Big Salaries

$35 to $55 a week is only a beginning. $100 a week and up is within your grasp as a practical Mechanical Draftsman.

Quick Promotion

You can climb up and up to salary and position—from Draftsman to Chief Draftsman—to Chief Engineer—to Production Manager—and so on up. You can also make big money on the side in your spare time, in addition to your regular salary. Then when the opportunity comes, you can go into business for yourself, as many others have done.

Permanent Employment

You won't have to stand around looking for a job. Properly trained draftsmen are always in demand. Railroads, Manufacturing Plants, Electrical Works, Engineering and Construction Houses and United States Government Departments always need trained draftsmen. Even when men in other lines of work are without positions, the draftsman is usually on the job at good pay.

Get the Right Training

"Columbia" training is simple and sure, yet complete and practical. By Roy C. Claflin's improved "Columbia" method of practical Mechanical Drawing you can become a master Mechanical Draftsman in a few months of pleasant, easy home study, under Mr. Claflin's personal supervision. No troublesome, fancy theories—no difficult mathematics to master—just the plain, common-sense brass tacks of Drafting. And after that, if you want it, you receive free training in a specialized branch of drafting, through your choice of one of our post-graduate courses.

Drafting Outfit Free

FREE We give you free with our course, this professional drawing outfit of sixteen pieces, and eleven piece set of highest grade drafting instruments in plush lined case. The entire outfit is yours to keep.

"Columbia" Draftsmen Are in Demand

The largest concerns in the country, including the United States Government, employ Columbia graduated draftsmen. Openings for draftsmen in Government Departments carry starting salaries ranging from $5.20 to $15.04 per day—and it is generally recognized that salaries outside of government service are still higher.

WHAT YOU GET FREE WITH COURSE

Practical Problems
You are carefully coached in practical drafting work.

We Help You Get a Job
We help you get a position as soon as you are qualified.

Training as a Drafting Specialist
After completing the course in mechanical drawing, we'll train you free in your choice of one of our special elective courses

Draftsmen's Equipment
A full set of professional equipment as shown in the picture below.

Consultation Privileges
You are free to write us any time for advice and suggestions.

Diploma
A lithographed, engrossed diploma attesting to your proficiency as a draftsman.

FREE SUBSCRIPTION TO DRAFTSMAN'S PUBLICATION "THE COMPASS"

U. S. Civil Service Commission Calls for Draftsmen

A few of the many positions open in Government Departments.

Architectural Designer—$4,000, Chief Draftsman—Naval Aircraft Factory, $15.04 per day.

Aeronautical Draftsman—Field Service of Navy Department, $5.20 per day to $12.00 per day.

Salaries are **starting** salaries, subject to increase. Practically all of them carry a bonus of $240 a year additional.

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Send in this coupon today. Immediately upon receipt of it we will send you FREE our illustrated book, "Your Future in Drafting." It tells you all about our new method of teaching Mechanical Drawing and gives full details of our offer.

Get started now

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Without obligation to me, please enter my name for a Free subscription to "The Compass" and send me Free your illustrated book on Drafting, telling how I can secure your complete home study course and your help in securing a position as draftsman.

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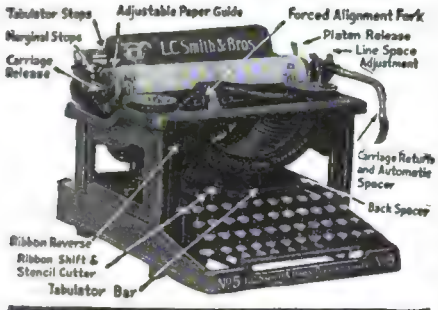

TYPEWRITER SENSATION

Free Trial—Use as You Pay

After trial send us only $5.00 a month until the low total price of $64.85 is paid, and the machine is yours. This is absolutely the most generous typewriter offer ever made. Do not rent a machine when you can pay $5.00 a month and own one. Think of it—Buying a $100.00 Machine for $64.85. Cash price $59.85, just a little more than half its original price.

L. C. SMITH No. 5

Perfect machines, Standard size, Keyboard of Standard Universal arrangement, 42 Keys, writing 84 characters—universally used in teaching the touch system. The entire line of writing completely visible at all times, has the tabulator, the two color ribbon, with automatic reverse, the back spacer, ball bearing type bars, ball bearing carriage action, ball bearing shift action, in fact every late style feature and modern operating convenience. Comes to you with everything complete; tools, cover, operating book and instructions—nothing extra to buy. **You cannot imagine the perfection of this beautiful reconstructed typewriter until you have seen it. We have sold thousands of these perfect late style machines at this bargain price and every one of these thousands of satisfied customers had this beautiful, strictly up-to-date machine on five days' free trial before deciding to buy it.** We will send it to you F. O. B. Chicago for five days' free trial. It will sell itself, but if you are not satisfied that this is the greatest typewriter you ever saw, you can return it at our expense. You won't want to return it after you try it, for you cannot equal this wonderful value anywhere.

Send No Money
Put in Your Order *Now*
$4.85 AFTER TRIAL

When the typewriter arrives deposit with the express agent $4.85 and take the machine for five days' trial. If you are convinced that it is the best typewriter you ever saw keep it and send us $5.00 a month until our bargain price of $64.85 is paid. If you don't want it, return it to the express agent, receive your $4.85 and return the machine. We will pay the return express charges. This machine is guaranteed just as if you paid $100.00 for it. It is standard. Over half a million people own and use these typewriters and think them the best ever manufactured. **The supply at this price is limited, the price will probably be raised when next advertisement appears, so don't delay. Fill in the coupon to-day—the typewriter will be shipped promptly.** There is no red tape. We employ no solicitors—no collectors—no chattel mortgage. It is simply understood that we retain title to the machine until full $64.85 is paid. You cannot lose. It is the greatest typewriter opportunity you will ever have. **Do not send us one cent. Get the coupon in the mails to-day—sure.**

Smith Typewriter Sales Co., Department 10 218 N. Wells St. **Chicago**

Smith Typewriter Sales Co. Department 10 218 N. Wells St. **Chicago**

Ship me the L. C. Smith Model No. 5, F. O. B. Chicago, as described in this advertisement. I will pay you $5.00 monthly as rent until the $60.00 balance of the SPECIAL $64.85 sale price is paid. The title to remain in you until fully paid for. It is understood that I have five days in which to examine and try the typewriter. If I choose not to keep it I will carefully repack it and return it to the express agent. It is understood that you give the standard guarantee.

Name .....

Street Address .....

City ..... **State** .....

Occupation or Business .....

Agents: 90c an Hour

Introduce "Sodereze." A new wonder. A pure solder in paste form. Works like magic. Stops all leaks. For mending water buckets, cooking utensils, milk pails, water tanks, tin roofs—everything including granite ware, agate ware, tin, iron, copper, zinc, etc.

Quick Sales—Nice Profit

Everybody buys. Housewive, mechanics, electricians, jewelers, plumbers, tourists, automobilists, etc. No leak too bad to repair. Just apply a little "Sodereze," light a match and that's all. Put up in handy metal tubes. Carry quantity right with you. Write for sample and special proposition to agents.

AMERICAN PRODUCTS CO., 5574 American Bldg., Cincinnati, Ohio

NEW STEEL FILING CABINET FOR LETTERS

The new all-steel filing cabinet shown in the accompanying illustration, has a capacity for 1,000 letters, and as may be seen, it is indexed in the usual manner. The principal feature about this cabinet is that a high grade lock is provided, so that no one can tamper with the file, whether it is used in the home or in the office. This lock is made with 144 different combinations, so that there is a very slight chance of the same key opening any two locks in a single office. The file cabinet itself is made of high grade No. 26 gage cold rolled black japan fender steel, the same as used for automobile bodies. The steel cabinet measures 6" x 10¼" x 12¼", and weighs four pounds when empty. This file will be found not only useful in offices for preserving important papers against fire and theft, but it will also prove its worth many times over in the home where such important papers as insurance policies, notes, stock certificates, private letters, and bill receipts, are frequently kept in a coffee pot or a piece of china seldom used, with the result that much inconvenience and trouble and sometimes a considerable loss of money ensues.

A Thief-Proof Lock and a Steel Container Ensure Letters and Documents Placed in This File Against Fire and Theft.

EMPLOYMENT BUREAU FOR ENGINEERS

The wide and varied field of engineering activity has created the need of some great clearing house of engineering services, from which engineers of any specific qualifications may be obtained.

In recognition of this want, the Federated American Engineering Societies, representing a combined membership of about 50,000, including the best and most representative professional engineers in the United States, has established at 29 West 39th Street, New York, an employment bureau for engineers of every variety of training and experience.

Applicants must be members and submit a complete educational and professional record which is carefully classified, so that as the special requirements of any position are received, the records of men of suitable qualifications are submitted for consideration. The relatively large number of men with whom the Bureau is in touch, the comprehensive classification of records, and the fact that the services of the Bureau are free to employer and member alike, renders possible the selection of the right man for the service required. Negotiations may be confidential if desired.

The high standards required for membership in any of the member societies insure the quality of men available and the Bureau will welcome inquiries from those seeking to build up or expand their engineering organizations in preparation for the activity now manifest.

ONE YEAR TO PAY! WHOLE

Cash-Price Bargains!

A SMALL deposit down is all the ready cash you need under the popular KLEIN plan. Examine diamond first, then decide. Order from this ad on **easy terms at cash bargain prices!**

We Trust You!

No annoying delays or red-tape to KLEIN credit. Deal direct and save the profits of all middlemen. Prices smashed to before the-war figures; act quick and KEEP HALF the diamond price in your own pocket!

$5 a Month!

Gorgeously hand engraved "American Beauty" solitaire Diamond ring, 14-kt. solid gold, $150 steel-blue-white perfect cut Diamond of dazzling brilliancy. Was $125, price smashed to only $79. $19 down, $5 a month for 12 months.

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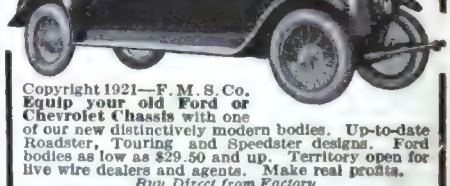

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Mercury Mirror to Bring Mars Close

(*Continued from page 601*)

having to use it in the one position only, we would have to wait until a star past directly overhead before we could see it.

We certainly would like to see this telescope yield good results, as it will mark a great step forward in the observation of the heavenly bodies, for we are practically right now at the end of our rope, when it comes to building large telescope lenses and mirrors. This was pointed out in a series of articles by Professor Floyd L. Darrow, on large astronomical telescopes, which appeared several years ago in this journal, and with our present knowledge of things scientific, it does seem almost pitiful that we have about reached our limit in the casting of pure masses of optical glass suitable for grinding a lens 100" in diameter, the largest in the world at present and undoubtedly for some years to come. Such seems to be the case, so some other means will have to be evolved of magnifying the image picked up in our present largest telescopes. It is calculated that the McAfee-Todd mercury-mirror telescope will magnify 25,000,000 times and the calculations already made show that Mars will several times in the year reach its zenith over the mine shaft at Chanaral, Chile, in 1924.

WHAT HAPPENS WHEN MARS IS SEEN ONE AND ONE-HALF MILES AWAY

Several Astronomical authorities have discust the possibilities of the 50 ft. diameter mercury mirror telescope and some of them have given us new light on the matter of magnifying Mars 25,000,000 times. What do you think we would see if we looked into the telescope provided by Professor Todd and Mr. McAfee. The surface of Mars, Professor Todd has stated, could be brought optically to within a mile and half of the earth, but contrary to our first impression perhaps, we would not be able to see the Martians at work if there are such beings, but all we would really see, so we are informed by astronomers, is a blur, for with the extreme magnification here attained, a point on the surface of Mars would move past our eyes at a speed of about ten miles per minute or about five times as fast as a racing car at the motordrome. If the observers were content with seeing Mars 15 miles away, the portion visible to them would still be speeding past the telescope at the rate of one mile a minute. In other words, if Mars were brought within a mile and a half of the earth, it would be whirling so fast that the characteristics of the landscape would be lost to our vision, in the same way as are the spokes of a locomotive wheel, or those of a fly-wheel on a steam engine.

It has also been calculated that with the magnification of 25,000,000 times, the light of Mars would be diminished to one twenty-five-millionth part of its brightness in the sky which would not, therefore, be sufficient for even the fastest instantaneous photography! So that even tho we do have cameras, which could make a stationary picture, of the rapid whirling Mars, (the same as we can take photographs of a 60-mile-an-hour locomotive, which show the spokes in the wheels), there would not be sufficient illumination to take photographs at such a speed. It is also thought by some astronomers that the well-known boiling effect of the atmosphere which prevents viewing the heavenly bodies clearly except from the highest elevations, would be intensified severely with such a telescope.

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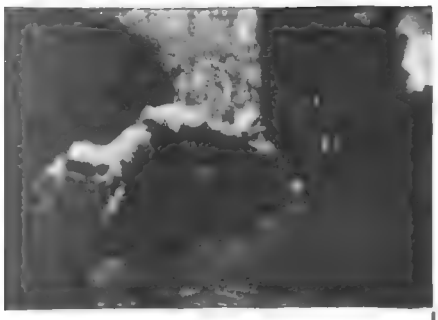

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New Tricks in Phonographs

(*Continued from page* 599)

by two bars on each side of the instrument. The instrument is set for playing and when the first record is completed, the tone arm automatically lifts itself and falls back, immediately a new record slips down on to the turn-table, partially cushioned by the natural air current, and then this record is played, and so until the last one is reached.

Do you ever stop to think that ordinarily you use only one-half the vibrations set up by the diafram in the phonograph reproducer? A new duplex reproducer which the editors have heard play successfully, is shown in the illustration herewith. As will be seen in the cut, a small horn is fitted to the side of the reproducer opposite to the side receiving the small end of the usual tone arm. This reproducer is supplied to fit any phonograph, with special clamping attachments where necessary, and the diafram is made of chemically treated wood. The stylus arm passes thru a small slot toward the center of the metal soundbox chamber, extending to the center of the diafram to which it is rigidly attached. A much clearer tone and a greater volume of sound are claimed for this reproducer, than that given by the present arrangements, and it seems to work very well.

Here comes the band! That is what the family would think if they heard a band record played on the new English phonograph shown, which uses a comprest air amplifier for boosting the sound to its natural and original volume. This comprest air amplifier is very simple, but of course as might be suspected, has to be built very accurately. Either in the phonograph cabinet or else separately, there is provided a small air compressor driven by an electric motor. From an air storage chamber comprest air is supplied thru a rubber tube to one side of the sound box of the tone arm, as shown in the illustration. As the grid-like valve is vibrated back and forth, due to the steel needle passing over the sinuosities of the phonograph record, fluctuating puffs of comprest air are allowed to pass thru the sound box and into the amplifying chamber. One man, who heard the machine play, stated that the voice, for example, from a vocal record was amplified to such an extent, that it made his ears ring, and he was glad when his host turned the lever which reduced the volume of sound to the normal strength of voice. A band record sounded, he said, just like a real band coming down the avenue. However, the average phonograph today, supplies all the volume of sound desirable for the home, and such amplifying phonographs are of most utility perhaps, in dance halls, theaters, et cetra, where the full effect of an orchestra or band is desired.

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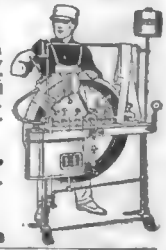

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Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 625)

Testing the Strength of a Base: Prepare a solution of potassium hydroxid by dissolving about 10 grams of the base in 250 cc. of water. When the solution has been thoroly mixed and cooled, fill a burette with it, having in the opposite holder of the burette stand a burette of half-normal hydrochloric acid. Run out about 20 cc. of the potassium hydroxid into a clean beaker and after adding phenolphthalein indicator titrate with the acid until the endpoint is obtained, stopping at the point where a single drop of the base will give a permanent tinge of pink.

Now from the fact that 1 cc. of half normal hydrochloric acid will exactly neutralize 0.02805 gram of potassium hydroxid, calculate the weight of base neutralized and the concentration of the solution, that is, the number of grams to the liter.

Titration of Vinegar: Vinegar is essentially a 4 or 5 per cent. solution of acetic acid obtained by the fermentation of cider or grape juice. In this process of vinegar making two fermentations occur. The first is the fermentation of the sugar present in the cider or grape juice to alcohol, and this is followed by the acetic fermentation of the alcohol to acetic acid. These changes are brought about by two distinct sets of ferments.

Testing the Acidity of Vinegar: Pure vinegar should contain not less than 4.5 per cent of acetic acid. To make the determination fill one burette with the vinegar and the other with tenth-normal sodium hydroxid, being careful to rinse out each burette with the solution which it is to contain before filling. Use phenolphthalein indicator and run out about 6 cc. of the vinegar into a clean beaker. Titrate with sodium hydroxid until the endpoint is obtained, never forgetting to rinse down the sides of the beaker and also the glass rod before this point is reached.

Then from the fact that 1 cc. of tenth-normal sodium hydroxid exactly neutralizes 0.006 grams of acetic acid, calculate the weight of acetic acid in the sample taken and the percentage of acid in the vinegar. This latter calculation is made by dividing the weight of acetic acid by the number of cubic centimeters of vinegar used in the titration.

Testing Soils: Soils are usually acid or alkaline. Old soils are acid and to neutralize this acid condition the farmer uses lime. Leguminous crops such as alfalfa and clover cannot be raised on acid soils. Therefore it is a matter of some importance to be able to determine whether a a soil is acid or not.

First thoroly dry some of the pulverized soil in an oven. Cool in a desiccator and weigh into a clean beaker 10 grams of the sample. Boil this in 30 cc. of water and filter, washing the residue with repeated small portions of hot water and allowing the washings to run into the original filtrate. Any acid or alkali that may be present will go into solution and be found in the filtrate. Add phenolphthalein indicator and note the result. If the soil is alkaline, the solution, of course, will be pink, but if acid no color will appear.

If the above reaction shows an alkali, it must be titrated with a tenth-normal oxalic acid solution. Oxalic acid may be obtained at any drug store. It is a crystalline substance and contains water of crystallization. The sample used in making the solution should consist of firm clear crystals which have not lost their

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water of crystallization. To prepare a tenth-normal solution dissolve exactly 6.3 grams of the acid in 1000 cc. of distilled water.

The solution obtained by boiling the soil with water is to be titrated, using the oxalic acid and tenth-normal sodium hydroxid in securing the endpoint. From the number of cubic centimeters of acid used subtract the number of cubic centimeters of hydroxid. The result will be the volume of acid actually used to neutralize the alkali in the soil. This result cannot be exprest in per cent. but from the quantity of acid required an approximate idea of the alkalinity of the soil can be had.

Should the soil be acid titrate the solution with tenth-normal sodium hydroxid and oxalic acid until the endpoint is obtained. Again subtract the volume of acid used in securing the endpoint from the volume of base used, and the result will be the quantity of base required to neutralize the acid in the soil. From the amount of this a fairly good idea of the acidity of the soil can be obtained.

Testing Soaps: Soaps may contain free or combined alkali. To determine if free alkali is absent, prepare an alcoholic solution of phenolpthalein, one containing no water. Place a drop of this solution upon the freshly cut surface of the soap. If no pink color appears, you may know that free alkali is absent.

Washing powders may be tested in the same way. Dissolve them in alcohol and test with the phenolphthalein.

Testing for Combined Alkali: Soap is defined as the sodium or potassium salt of a fatty acid. Since this is the salt of a strong base and a very weak acid, by a process known in chemistry as *hydrolysis*, a water-solution of soap will always give an alkaline reaction.

To determine the amount of combined alkali dissolve 1 gram of the soap in 25 cc. of hot water and add phenolphthalein. A pink color will immediately appear.

Titrate with tenth-normal oxalic acid adding the acid very slowly and with constant stirring. Continue until a single drop destroys the pink color. If, upon standing a minute or two, the pink color reappears, add another drop of the acid.

One cubic centimeter of tenth-normal oxalic acid neutralizes 0.004 grams of sodium hydroxid, which is the alkali present in hard soap. Therefore from the number of cubic centimeters of oxalic acid used calculate the weight of sodium hydroxid and the percentage of alkali.

Determination of Free Alkali in Soap: Dissolve 1 gram of soap in alcohol. Filter out any insoluble matter and wash the residue with alcohol, allowing the washings to run into the filtrate. Titrate this filtrate with tenth-normal oxalic acid as before and in the same manner calculate the sodium hydroxid present.

Determination of Total Alkali: Weigh 2 grams of the soap into a porcelain crucible and burn to an ash over a Bunsen burner. When cold dissolve the ash in 50 cc. of water and boil to insure complete solution of all the alkali present. Using methyl orange as the indicator titrate with N/10 (tenth normal) oxalic acid. As before add the acid slowly and stop with the drop that just changes the orange color to pink. Should this point be exceeded, N/10 sodium hydroxid may be used in securing the endpoint, the volume so used being subtracted from the total volume of acid. From the result calculate the total amount of alkali present.

Testing the Strength of Household Ammonia: Buy a bottle at your grocer's and fill one of your burettes with it. Fill the other burette with N/2 (half normal)

Hail, Noble!

THE campfire burns low and the Temple lights are flickering. Verily, the desert sands have been very hot, and the Caravan has covered many weary miles. We thirst for orders! Incline thy gracious head and lend us thine ear.

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hydrochloric acid. With ammonia the phenolphthalein indicator is unreliable. Therefore use either methyl orange or litmus.

Run into a clean beaker about 15 cc. of the ammonia, add the indicator and titrate until the endpoint is obtained. Calculated as ammonium hydroxid 1 cc. of N/2 hydrochloric acid will neutralize 0.0175 grams of the hydroxid. Therefore the weight of ammonium hydroxid in the sample used can be determined and also the percentage. Assume that the density of the household ammonia is 1, that is, that 1 cc. of it weighs 1 gram, which is very nearly correct.

Determination of Chlorin in Water: The amount of chlorin in water is determined by titration but the standard solution used is neither an acid nor a base. We use instead a solution of silver nitrat. To prepare this solution dissolve in a liter of distilled water exactly 4.8 grams of silver nitrat crystals.

For the *indicator* use a solution of potassium chromat made by dissolving 2 grams of the salt in 100 cc. of water.

The presence of chlorin in drinking water always indicates contamination, unless it can be directly traced to some known source. The chlorin in itself is not harmful, but its source, when present in abnormal quantities, is usually sewage and animal wastes.

To make the determination, measure 100 cc. of the water under examination into a very large test tube or Nessler tube. Add 1 cc. of the potassium chromat indicator, which will give a pale yellow tinge to the water. Then add silver nitrat solution from a burette very slowly until the distinct red tint of silver chromat is just visible.

Each cubic centimeter of the silver nitrat is equivalent to 0.02432 grams of chlorin. Therefore from the number of cubic centimeters used calculate the amount of chlorin in the sample. Express this result in milligrams, that is, in thousandths of a gram, and multiply the result by 10, since only 100 cc. of water were titrated. This final result will be the number of parts per million of chlorin in the water. If the water contains more than 50 parts per million contamination from human waste or sink drains is indicated.

Determination of Organic Matter in Water: This determination is also made by use of a standard solution, in this case a solution of potassium permanganate. Prepare the solution by dissolving 0.395 grams of the salt in a liter of distilled water.

Place exactly 70 cc. of the water in a clean porcelain dish and add a dozen drops of a 10 per cent. solution of sulfuric acid. Warm gently and from a burette add the standard solution a drop at a time, stirring with a clean glass rod after the addition of each drop. When the first faint tinge of pink appears, warm the dish again and notice whether the color is permanent. If not, another drop must be added. Stop the titration when the color becomes permanent.

The disappearance of the color of the permanganate solution is due to reduction by the organic matter present. When 70 cc. of water are used, 1 cc. of the permanganate solution used in titration means 0.1 of a grain per gallon. If more than one grain of permanganate per gallon is absorbed, contamination is indicated.

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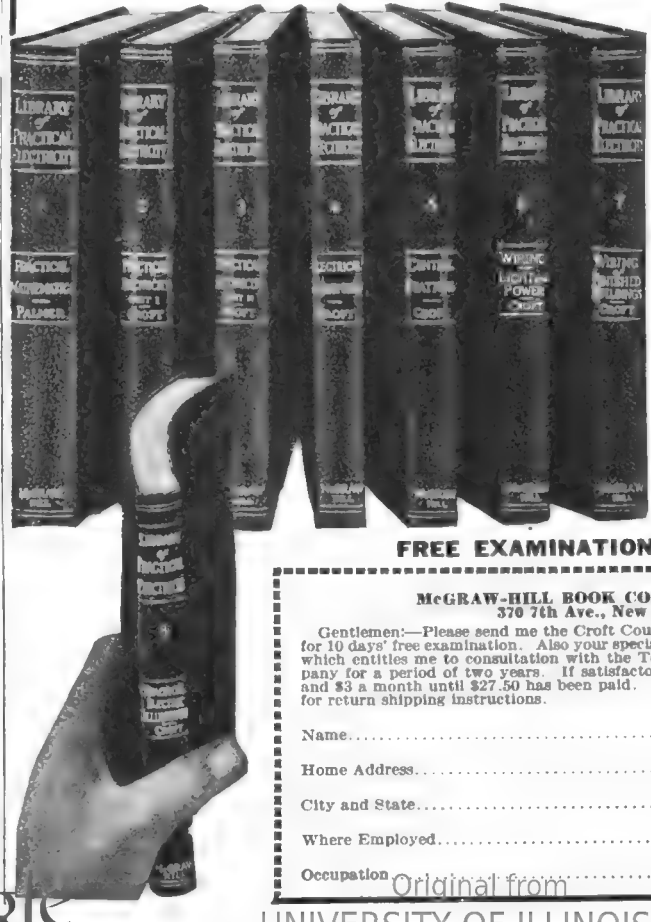

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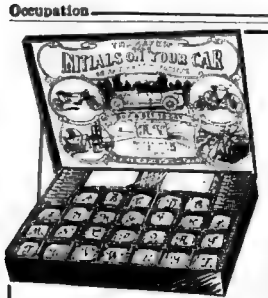

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Earthquakes Made to Order

(*Continued from page* 604)

motion pictures of a real volcano in action. The lava was produced with a whitish fluid resembling white-wash, which was stored in large tanks back of the hill serving as a volcano, as shown in the illustration, and when steam was admitted into these tanks, the pressure caused the boiling white fluid to be forced up and out of the pipes connected to the tanks, the various pipes leading to a number of different openings just below the crater, so that the lava fluid flowed down the sides of the hill thru crevices previously prepared by the scenic artists and designers.

These crevices as well as the pipes supplying fluid to them were of course not noticeable in the motion picture, but when the black pall of smoke overhung the scene, and the white fluid boiled down over the side of the volcano, the effect was striking and awe inspiring indeed.

Three New Science Wrinkles

(*Continued from page* 616)

and inserted about two inches into the reversing reel. No fastening whatever is required as the fingers hold the film down; herein lies the condition which keeps the film from creeping. The film is not wound in a round form but is pulled from point to point inside the fingers, thus winding the film in the form of a decagon. Each machine is equipt with special expanding core reels. One half of a reel is placed in the machine before winding, and when the operators are ready to remove the film the other half of the reel is snapt on, and the film is then pulled out, rolled on its reel and ready for immediate showing. This new invention saves the tedious task and disposes of the possible damage done in rewinding.

THIS WHEEL HYPNOTIZES

The wheel shown in the accompanying illustration is said to hypnotize the person who looks at it as it slowly revolves, and in about ten minutes the senses, especially the memory, will become dulled and, a little later, strange emotions are experienced by those who are able to retain a passive mind. This wheel is made of cardboard driven by a clockwork motor, but an easier method is to attach it to a revolving electric fan, which must be geared down or controlled by a rheostat so as to revolve very slowly.

What are Sand and Water Spouts?

(*Continued from page* 616)

witnest, is the sand column storm. Of this remarkable phenomenon we give the following from "Evenings In My Tent" by the Rev. N. Davis.

"The heat during the day had been intense. The thermometer in my tent, during the day and night, had been almost stationary at 100 degrees. The wind during the day was hot as flames issuing from a furnace; and the clouds of sand it raised, and carried along in its furious march, were immense. In the distance could be seen numbers of sand columns; but these did not retain their forms any considerable time. A contrary blast brought them into collision with each other, and the blending their contents, raised a complete [illegible] barrier between us and the

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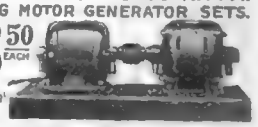

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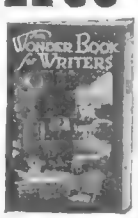

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country beyond. Being no lover of danger, yet I must confess I was very desirous to see this phenomenon—one of the horrors of the desert—in greater perfection.

"Bruce, the African traveler, is said to have witnest one of the most stupendous exhibitions of sand columns or sand spouts, caused by circular air movements or whirl-winds, on record. In his journey thru the desert of Senaar, his attention was attracted to a number of prodigious pillars of sand, at different distances, moving at times with great celerity, at others stalking on with majestic slowness; at intervals, he thought they were coming in a very few minutes to overwhelm him and his companions. Again they would retreat, so as to be almost out of sight, their tops reaching to the very clouds. There the tops often separated from the bodies, and these, once disjointed, dispersed in the air and were seen no more. Sometimes they were broken in the middle, as if struck with a large cannot shot. About noon they began to advance with considerable swiftness upon them, the wind being very strong at North. Eleven of these awful visitors ranged alongside of them, at about a distance of three miles. The greatest diameter of the largest appeared to him, at that distance, as if it would measure ten feet. They retired from them with a wind at south east, leaving an impression on the mind of the intrepid traveler to which he could give no name, tho he candidly admits that one ingredient in it was fear, with a considerably deal of wonder and astonishment. He declares that it was in vain to think of flying; the swiftest horse, or fastest ship could be of no use to carry him out of his danger, and the full persuasion of this riveted him to the spot where he stood.

"Next day they were gratified by a similar display of moving pillars, in form and disposition like those already described, only they seemed to be more in number and less in size. They came several times in a direction close upon them; that is, according to Mr. Bruce's computation, within two miles. They became immediately after sunrise, like a thick wood, and almost darkened the sun, his rays, shining thru them for nearly an hour, gave them an appearance of pillars of fire. At another time they were terrified by an army of these sand pillars, whose march was constantly south, like an army of giants moving to battle, a number of which seemed once to be coming directly upon them, and, tho they were little nearer than two miles, a considerable quantity of sand fell around them. This strange and wonderful phenomenon is often succeeded or accompanied by the terrible simoon, under whose pestilential influence all nature seems to languish and expire.

"The only means of escaping these destructive blasts, is to lie flat on the ground until they pass over. Instinct even teaches animals to bow down their heads and bury their nostrils in the sand. Clouds of sand rise in such quantities, that it becomes impossible to see to the distance of a few yards. In these cases the traveler generally lies down on the lee side of his camel, but the sand soon covers them, and they are obliged frequently to shift their places to avoid being entirely covered. Caravans are sometimes swallowed up in this manner; and whole armies have perished miserably in these inhospitable deserts."

The sand columns are not solid but are formed of a whirling wall of sand particles, partially transparent, which permits the light shining thru them giving rise to the golden color spoken of by the Rev. Mr. Davis.

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Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page 607*)

the higher latitudes. The period of rotation for spots at the equator is 9 hrs. 50 min. and for spots in high latitudes about 9 hrs. 57 min. so that the equatorial regions are continually gaining in rotation on the regions in higher latitudes. Owing to the rapd rotation of the planet on its axis and its great size, points, near the equator, are carried around with a tremendous velocity, amounting to 30,000 miles per hour. Two markings with different rates of rotation frequently pass one another with a relative velocity of over three hundred and fifty miles per hour.

Of all markings the Great Red Spot seems to be the most sluggishly moving. For the first eight years after it attracted universal attention its rotation period increased and then began to decrease and of late years has remained fairly constant. This has been interpreted by astronomers to mean that it was at first considerably elevated in the atmosphere of the planet so that its rotation period was, as a result, longer, but has since dropt back to a lower level. The small brilliant spots of various colors that are continually appear-

The Reason Why a Satellite Could Not be Formed by a Protuberance on the Surface of the Planet Being Severed Therefrom Gradually, is Shown in this Diagram, Which Illustrates the Application of Roche's Law, Which States that 2.44 Times a Planet's Radius Represents the Least Distance at which Any Satellite Could Resist the Tidal Strains Produced by the Attraction of the Planet's Greater Mass. Referring for the Moment to Our Own Moon, this Law Shows that it Could Never Have Revolved at a Smaller Distance Than 11,000 Miles from the Surface of the Earth, for Otherwise it Would Have Been Torn to Pieces and Given Rise to a Ring of Fragments Revolving About the Earth, the Same as the Rings Surrounding Saturn.

ing in the atmosphere of the planet, move more rapidly than the Great Red Spot and, therefore, are continually passing it.

It has also been observed that these spots invariably turn aside upon passing the Great Red Spot as if repelled by it, and it has been noted that it exerts always a strong repellent effect upon all neighboring objects.

The most remarkable fact about the Great Red Spot has been its changes of color. When first noted it was a pale pink in color, and so not particularly conspicuous. Within a year or so its color had deepened to a brick-red and it became the most conspicuous marking in sight. It retained this deep red color for a number of years and then gradually faded to a pale pink as if it were sinking back beneath a veil of whitish vapors or clouds. There have been fluctuations in its color since then, and temporary revivals of its former brightness, but it has never regained for any length of time the splendor that it possest in the years immediately following its discovery in 1878. Apparently the deep brick-red color that made it so conspicuous an object in those years was due to the upheaval to a high altitude in the planet's vaporous envelope of some highly-heated pasty mass that

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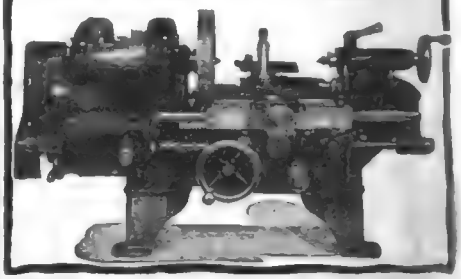

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normally lay at great depths and which was deep red owing to its great heat and possibly to its physical composition as well. Subsequent temporary renewals of the same force would thrust the sinking mass to high altitudes once more and make it more clearly visible to us, thru a thinner veil of intervening gases. Thus its later variations of color could be accounted for.

The oval shape of the Great Red Spot is very noticeable. Its length is more than three times its width. In fact, we may bear in mind that it is about equal to the diameter of the earth in width and to its circumference in length. Its depth is, of course, unknown but it is evidently free to drift in the atmosphere of the planet. Now the largest satellite of Jupiter is only about 3,500 miles in diameter, so if a satellite of the size of the Great Red Spot were to be launched into the Jovian system it would greatly exceed our own world in size, and would radically change the orbital motions of all the present members of the Jovian system, thru the perturbations produced by its gravitational attraction.

The oval form of the Great Red Spot may be caused, conceivably, by the action of the rapidly moving currents in which it is adrift, which might tend to increase its length in a direction parallel to the equator and by friction, possibly, to wear off its eastern and western extremities. Since it moves more slowly than adjacent markings it is caught in a swiftly moving current of gaseous vapors and its canoe-like form is possibly the one most likely to be assumed by an object floating in such a sea of vapors.

Were it an *embryo satellite* about to leave the plant, its longer axis would be pointed toward the center of the planet, and we would see this longer axis end-on and not parallel to the planet's equator. The position of the Great Red Spot just at the southern edge of the south equatorial belt causes us to think that it has been pushed aside by the rapidly moving currents of this mighty atmospheric stream, to whose border it still clings.

The Great Red Spot exerts a strongly repellent action upon all adjacent markings but most noticeably upon the small, brilliant, white spots, apparently cloud-like vapors, that often overtake and pass it, but which conveniently turn aside and skirt its outer edges as if repelled. There evidently resides within the mysterious oval spot a strong *magnetic field* and there are also indications that *changes in the sun's magnetic field affect the brightness and visibility of the Great Red Spot.*

The Jovian satellite system has the appearance of well-ordered finality. The planet itself is in a turbulent state, it is true. It evidently possesses a high internal temperature and tho it plainly furnishes no light to its satellites, it may send forth into space a small amount of heat. Its high internal temperature, aside from that supplied possibly by radio-active substances, is due partly to inherent heat and partly to the tremendous pressure exerted by its dense atmosphere which is apparently composed of cloud-like vapors of many substances. A transfer of this heat to the surface produces the dense gaseous envelope of the planet which plainly exists, in spite of the fact that the planet receives only one twenty-seventh as much light and heat per unit from the sun, as is received by the earth. We would expect to find it endowed with a frigid surface covering, unless if it possest some internal supply of heat of its own.

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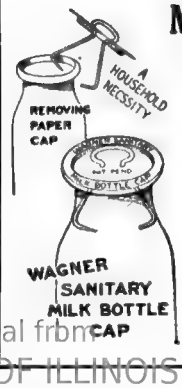

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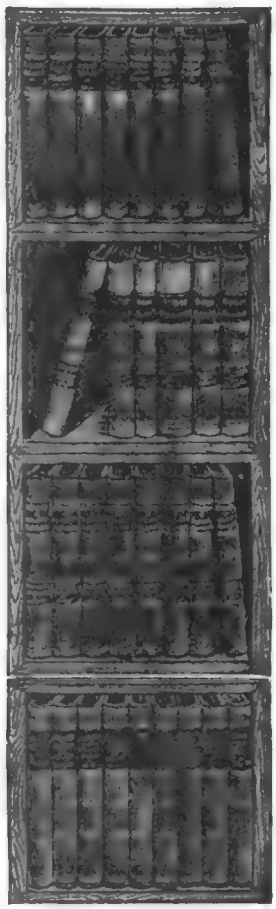

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teen hundred spheres the size of our own, it is practically assured that no new satellite is likely to be expelled from the parent-mass. Certainly no known forces, at work within the Jovian system, could cause a mass, far greater than our own earth in size, to be suddenly launched forth to a distance from the planet of at least one hundred and ten thousand miles, and unless expelled to this distance at the time of its birth, the newly-born satellite would be pulverized and reduced to a ring of matter encircling the planet, in the manner of the rings of Saturn.

In the dim and distant past it is possible that the satellites of Jupiter were formed from the mass of the huge planet simultaneously by the ejection of a stream of matter from the planet under the influence of some great external attractive mass, or even thru some internal cataclysm, which released suddenly the material for the creation of satellite worlds. However that may be, the system now has the appearance of completion, tho chaos still reigns upon the planet itself, and leads us to believe that the huge planet is a world in the making. However great may be the changes destined to take place in this planet world, we feel reasonably assured that its satellite-forming process is complete, and whatever changes take place in the future in the Jovian system no new members will be added to our list of the family of Jupiter, except possibly thru the discovery of minute satellites that are already in existence, but which have so far escaped the watchful eye of the astronomer.

Editor's Mail Bag

(*Continued from page 622*)

thus there are chemical journals, and astronomical journals, etc., for those wishing pure technical matter. SCIENCE & INVENTION *aims to cover* ALL *subjects, feeling that even the most rabid technical man can enjoy articles on subjects which he does not see every day.*
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Having finished reading the columns of the "EDITOR'S MAIL BAG", published in the August issue of SCIENCE & INVENTION, I am writing my views.

To begin with, SCIENCE & INVENTION is the best publication today in its line, in my opinion. Let us look through the August issue. What do we find which cannot be termed scientific? Nothing.

Some of the smartest men of today seem to think that science applies only to the particular study in which they are interested. A first year book in chemistry or electricity is just as scientific, in the real meaning of the word, as those which have to deal with the highest point attained in chemistry or any other science.

A few writers say that the SCIENCE & INVENTION publication is gradually becoming a mere boys' magazine. Do they not stop to think of the thousands of young men and boys, who, by performing the experiments and reading the articles in this worthy magazine are getting practical training, and that these young men and boys are to be the scientists of the future? Surely our learned men of today are not going to begrudge the coming generation a chance to learn. If some of them would sit down and write an article to help the boys along instead of all this criticism, I think all concerned would profit much more by it. I am for SCIENCE & INVENTION just as it stands. No changes are necessary.

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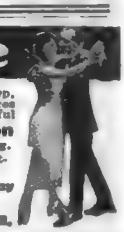

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Have We Neighbors In Space?

By IVAN L. SMITH

(*Continued from page* 600)

"seas" as old sea-bottoms, a trifle swampy perhaps, after a polar thaw, but land, nevertheless. Rivers there are none; and the absence of rivers or seas speaks eloquently of the absence of rainfall. Lowell, in referring to the weather of Mars, states that "it (rainfall) is distinguishd by its pleasing absence." The fact that the Martian water supply is extremely limited should be borne in mind, as it is a fact of great significance.

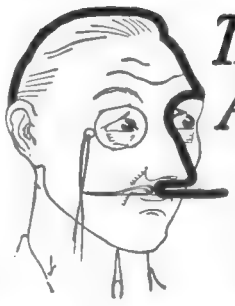
We cannot be certain of the range of temperature found on Mars. It cannot be denied that the polar caps melt in spring, which argues a summer temperature above freezing, just as their presence predicates a winter temperature below that figure. Since there is moisture in the air, but no condensation over the tropical regions in the form of snow, it is evident that the temperature in these regions is always above freezing. From such scanty evidence as we have at hand, we would be reasonably safe in saying that Mars has a mean temperature, which, while undoubtedly somewhat lower than our own, is, nevertheless, not unfavorable to plant and animal development.

Summing up the foregoing, which is in reality little more than a brief synopsis of the evidence gathered by Lowell and his associates, it will be seen that Mars is capable of supporting life, since it has days and seasons subtantially like our own, an atmosphere, a temperate climate, and a small amount of water. Having shown that there is no feature of the Martian planet which would tend to render the existence of plant or animal life impossible, it is necessary to find proof that life actually does exist there before the hypothesis can be considered as definitely proven.

Such proof has been found in the discovery of the "canals." Credit for their discovery must go to the Italian astronomer, Schiaparelli, but it is Lowell's conscientious and untiring observations which have revealed their true character and extent. The planet's surface has a cobwebby appearance. A network of lines of "individually uniform width, exceeding tenuity and great length" encompass the globe from pole to pole. Their absolute regularity makes them "joys of geometric beauty." Attempts to disprove their artificiality have not met with noteworthy success. They have been successively "explained" as "earth-cracks," "crater-fissures," "river beds," etc. No natural phenomena within our knowledge, however, would produce lines which are mathematically straight, which have uniform breadth, definite beginnings and endings.

The outstanding characteristic of the canals is not their regularity so much as it is their relation to each other. "Each not only proceeds with absolute directness from one point to another, but at its terminals it meets canals which have come there with like forthrightness from other far places upon the planet. Nor is it two only that come together at a common junction—up to as many as fourteen sometimes thus make rendezvous, and it is a poor junction that cannot show at least six or seven." Such an arrangement cannot be the result of chance. Nature does not work with a rule and compass.

The canals begin at the source of the planet's only water supply—the polar regions. Something, indeed, they penetrate,



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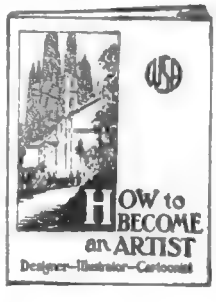

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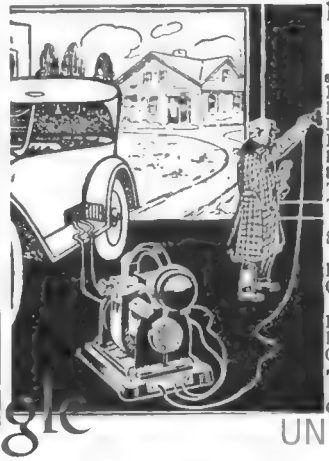

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the polar caps for a distance. From the poles the canals proceed with astonishing directness to points far down on the planet's surface, there to meet other lines, which arrive at that point with an equal directness. They form a network, amazing in its comprehensiveness.

Perhaps the strangest feature of the canals and one of the most conclusive bits of proof as to their artificial origin, is the fact that at certain times a large number of the canals assume a double construction. The twin lines of the double canals stretch absolutely parallel, like twin rails of a railroad track across our western plains. The fact that the doubling of certain canals occurs at a time when the polar melting has just passed its height seems to give a clue as to their purpose.

Another significant feature of the canals is the evidence they show of seasonal change. During the winter months the canals are so faint as to be invisible in may cases. With the advent of spring and the melting of the polar caps, a singular change takes place. Beginning at the snow-line, the canals assume a blue-green color. The change sweeps down the face of the planet as the summer season progresses until eventually the entire canal system has taken on this greenish tinge and is plainly visible. With the approach of autumn the color changes, and instead of green the canals become a reddish-ochre or russet, remaining thus until winter, when they grow gradually fainter, often disappearing altogether.

This seasonal change of the canals is an excellent indication of their character. Nothing known to us exhibits these seasonal changes except vegetation. An observer, watching the earth from a distance, would note this same change taking place over the fertile regions of the earth. Appearing indistinct at first, the vegetation would assume a blue green color with the approach of summer, remaining so until the coming of autumn gave it the glorious red, yellow and orange tints we know so well.

The great difference in the two processes is that while on the Earth the annual awakening sweeps from the tropics poleward, on Mars the reverse is the case. On Earth the process awaits the warming rays of the advancing sun; on Mars it is undoubtedly the equatorward sweep of the waters released from the polar caps, which produces the awakening into life.

Heretofore the lines visible in our telescopes have been referred to as canals. So named before they had been studied intensively, the appellation was, in reality, a shot in the dark. Later investigations seem to prove that the pioneers made a very good guess. The lines are, by actual measurement, as much as eighty miles in breadth. This great breadth, taken in connection with the color changes, seems to indicate that we do not actually see canals. However, from what we know of the planet there can be little doubt that the lines are bands of vegetation, and their position and behavior indicate strongly that they lie along the courses of artificial waterways. So we do not see canals, but we do undoubtedly see vegetation, which indicates the presence of canals.

Any attempt to ascribe particular characteristics, mental or physical, to the Martians would be futile. We can only guess from what we see of conditions prevailing on the planet, what form their bodies and intellects have assumed to meet these conditions. Mars is, from the standpoint of development, older than the Earth; and we may well expect its inhabitants to be proportionately advanced. Their lungs are probably vastly larger than our own, because of the rarefied atmosphere, the

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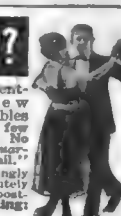

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lessened gravitational attraction would render limbs far less bulky to be sufficient to support an equal weight compared with conditions on the Earth. Their knowledge of engineering and mathematics must at least equal ours, to enable them to conceive and execute a project as stupendous as the irrigation of an entire planet. The comprehensiveness of the canal system shows that its construction was in nowise hindered by division of the planet into small commonwealths. They have evidently learned to act as a unit and national boundaries must be unknown.

A study of Mars should arouse in us more than a mere academic interest. Planets have their life cycles, just as plants, animals, nations and races have. The Earth is now in the period of early maturity, when all the necessities of life are to be found in abundance. Old age is inevitable. Shrinkage, loss of internal heat, thinning of the atmosphere, and gradual disappearance of water are in store for our earthly abode, just as certainly as that they are an accomplished fact on Mars. It is not folly to prophesy the coming of a time when the races of the Earth, laying aside their petty differences and quarrels, will be compelled to fight as a united world for the precious dwindling drops of water which postpone the day of their extinction. In this state we find the Martians—to this state must we also come.

A New Nose without Cutting the Skin

By A. N. MIRZAOFF

(*Continued from page* 597)

Deflected noses are treated according to the kind of deviation. When the whole of the nose is deflected it is necessary to operate upon the bones until they are straightened. But some noses are not straight, because of the cartilaginous portion and the operation may require the removal of some of the cartilage and the *turbinates*, which not only remedies the defect but enables the patient to breathe comfortably. To bring the nose to the final proper shape it is necessary to wear certain instruments which are inserted for a few hours each day.

Concave noses range from all degrees of the barely perceptible to the most detrimental defect. An accident may be the cause, or one may have inherited it, but in either case the surgeon can make a member that satisfies his ideal. In some cases the skin is lifted and hard paraffin is injected to fill the dent. Dr. Bourguet emphasises the fact that *hard paraffin* must be used. Accidents have been produced and bad effects have resulted from the injection of soft paraffin or vaseline. The hard material remains in the spot where it has been injected until it finally becomes a virtual part of the structure of the nose.

Questions for Young Scientists

(*Continued from page* 633)

(b) Your breath turns to a liquid.

Thunder is caused—

(a) When two clouds bump together.

(b) Lightning causes a partial vacuum and air rushes in.

(c) It is an echo of the lightning.

Telephone wires are stretched loosely if put up in the summertime because—

(a) There are many storms in summer.

(b) Snow weighs them down in winter.

(c) They would be too tight when they contract in winter.

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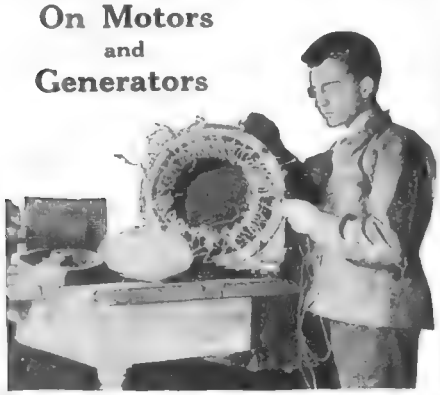

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Our Glands—Their Importance to Health

By JOSEPH H. KRAUS

(*Continued from page* 609)

erence to the body system, can only be determined by experimental proof. For instance, in certain operative cases, as goitre, it becomes necessary to remove a large portion of this gland, sometimes even as much as nine-tenths of it. This gland may also atrophy or shrink up and become practically useless. Let us now see what the result of such an affliction is. If the patient is an adult, it will be found that his or her mental activities are considerably blunted. The face and hands may appear swollen and puffy, and the patient may present a yellow and waxy appearance, while his pulse will slow down and his hair fall out. This indication is generally found in all individuals, who suffer from insufficient thyroid activity, and is generally corrected by administering medicines, which have as their basis the thyrod gland of a sheep, which has been dried and pulverized or from which a form of extract has been made.

View of Brain, Showing Location of Pituitary Body, One of the Important Glands.

Should this gland and its functions become accidentally deranged, and a lack of secretion become evident in an infant, a midget is the result. The midget is called a cretin, when speaking in medical terms. The growth of the skeleton practically ceases and altho the bones may become heavier, they do not increase in size. Children affected in their fifth or sixth year may live to the age of 25 or 30, or perhaps even a little longer, but they constantly present a shrunken appearance, and in many cases a 25-year-old cretin has the intelligence of a child six or seven. In rare instances, they do become educated and some of them can converse in eight or nine languages. I have personally talked with such a little lady, measuring just 24 inches high. This malady can likewise be corrected by administering the thyroid gland extract in any of its many forms. Experiments to transplant the thyroid gland have been quite successful in animals, altho in man the results are not so promising. Complete extirpation of the thyroid gland is seldom, if ever, performed.

Situated on the border of the thyroid gland are some very small bodies, varying in number, known as the parathyroids. Not very much is known of these bodies, with the exception that, in removal of the thyroids, the condition resulting can be corrected by administering the gland ex-

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tract internally, but when the parathyroids are removed severe nervous disturbances are the result. Sometimes these disturbances are followed by tetany, resulting ultimately in death. Tetany is a spasmodic contraction of muscles occuring with great rapidity.

We know therefore, that if we desire to develop a race of midgets, we would only have to ligate or cut the arteries leading to the thyroid gland. We also know that a cretin (midget) develops under therapeutic doses of the gland. The administration of this glandular substance to a perfectly normal man quickens the pulse, increases the appetite, and raises nitrogenous output with the subsequent diminution of superfluous fat.

Situated in the base of the skull is a small, almost insignificant body or gland called the pituitary body. This consists of a posterior lobe, an anterior lobe, and an intermediate portion. It has been associated by many investigators with a variety of activities. The effects of the posterior lobe have been claimed to act upon muscle fibers of the smooth muscle variety, that is those muscles which are involuntary in their action, such as the muscles in the walls of arteries. It is also supposed to have an effect upon the kidney and the mammary glands of lactating animals. Nevertheless extracts of the pituitary gland also contain extractives from the intermediate portion of the gland. Extractives from the anterior portion seem to have no effect, but its surgical removal invariably proves fatal. This death cannot be attributed to shock as a result of the operation, and, therefore, one must regard the pituitary body as being essential to life. Tumors of this gland result in an increased growth of certain parts of the skeleton, sometimes of the whole skeleton; when the disease occurs during the period of active growth, the result is a giant. Whether this is due to an over-action or a failure of action on the part of this gland, is not yet definitely known. Needless to say, many properties are ascribed to this gland, which in actual practise apparently are not borne out.

Very little can be said here about the other ductless glands. The thymus, which in man grows until the second year of his life, rapidly diminishes so that only traces can be found in the fourteenth to sixteenth year. In certain cases of general weakness in young people, the thymus may be found to be still persistent. And as far as we know there is very little function on the part of the pineal, coccygeal and carotid glands. The spleen, a very large gland may be looked upon as being a great blood purifier or filter.

Today we hear of the wonderful work being done by many surgeons on *the rejuvenation of the aged*, a veritable fountain of youth, as it were; and glands are being transplanted from monkey to man with some results, but many more failures. We are living today in an age of speed, and everything is occurring much more rapidly, people are growing up into manhood and womanhood in more rapid strides; they are losing their vitality earlier in life, and death knocks upon our doors, when we really should be just beginning to enjoy ourselves. One reads of reports of actual operative procedures and flamboyant reports of the restoration of physiologic powers that are lost. Professor Steinach has proven that the survival of sex glands in transplantations depends entirely on whether or not the sex glands have been lost originally. If not, the transplanted gland will die

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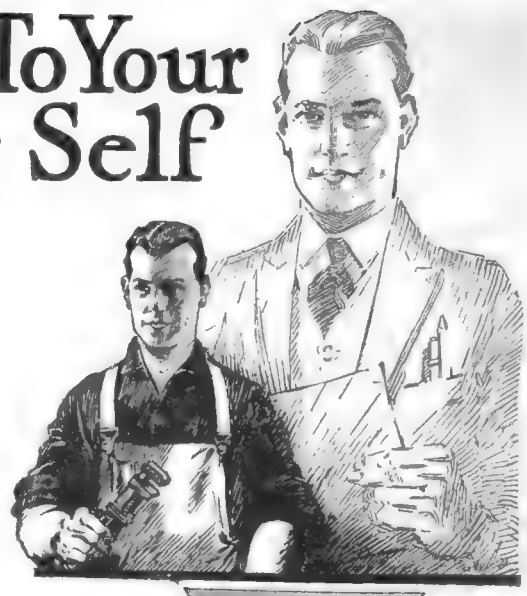

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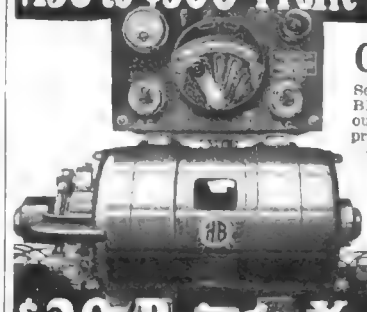

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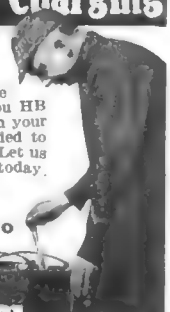

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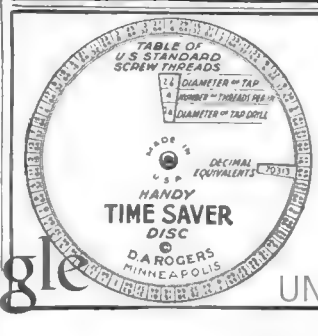

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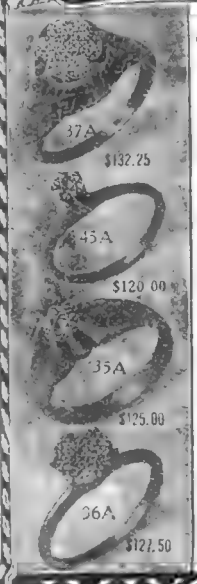

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Ordinarily, however, such transplantation altho not always developing normally, shows secondary sexual characteristics, such as, a change in voice, etc. In these transplants, fatigueability and increase in vitality and the return again of a once failing memory, has become manifest. Many cases of this nature are reported and altho the possibility of rejuvenation strikes us in view of the newspaper reports, as being of tremendous importance, the laity has undoubtedly had false hopes instilled into it. The 140 year class will come without a doubt and we will again be able to live to a ripe old age, but perhaps not with present gland transplantation means.

A Macrophotographic Camera

By DR. ERNEST BADE, Ph.D.

(*Continued from page* 598)

When the object has been focused, replace the ground glass in its position, and close down the iris diafram of the lens until the details of the object *furthest from the lens* are sharp and distinct.

Then cover the lens with a cover fitting light-tight. This latter can be made from a piece of cardboard and some velvet or other piece of thick cloth. Cut the cardboard into a circle about one-quarter of an inch larger than the greatest diameter of the lens. Cut a strip of cardboard about one inch wide and long enough to fit snugly around the disk. Take some paper and glue the two pieces of cardboard together. When this has dried, take the cloth and glue to the bottom and inner sides. Then see if this cover will fit over the lens.

When the lens of the camera has been covered, put in the plate, take a watch and expose by removing the cap from the lens. When exposed, put the cover on the lens again, take out the plate and develop.

Novel Electric Shutter Release

(*Continued from page* 629)

of the camera front, therefore only approximate dimensions will be given. The disc B may be cut from thin fret wood or laminated veneering, and may be from one-and-a-half to two inches in diameter. A small brass bolt or screw, an eighth-of-an-inch in size, serves as pivot. The standard F and the base board G can also be made of the same wood, the standard will, most likely, have to be from two to three inches high. Part of the disc must now be cut away, so that it is about one-sixteenth-of-an-inch above the release lever when the gear is set. Furthermore, a small hole, about one-eighth of an inch in diameter, must be drilled thru the disc where shown in the sketch, this hole takes the rubber band. A narrow slot must be cut to the edge of the disc to allow the endless band to be slipped into the hole. For the band, we might use one of the endless rubber bands sold in stationery stores.

The binding posts should be as light as possible, as the wire they are going to take is very fine, as a matter of fact, the finer the better. If you are unable to get very fine fuse wire, you can make this wire yourself by etching florist's wire down with dilute nitric acid; only a small central part need be etched thin, so that the ends retain their original thickness and can be more easily attached to the binding posts than a very fine wire. The flash-lamp battery should be quite new, it would be still better to use a small flash-lamp accumulator, to insure an instantaneous firing of the wire D.

Contributed by C. A. OLDROYD.

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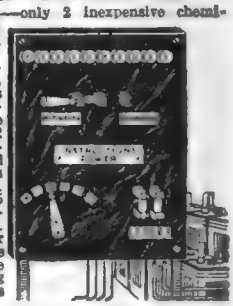

Note—There is no other literature describing this battery outfit nor are there any agents or stores selling it. **Order direct from this advertisement.**

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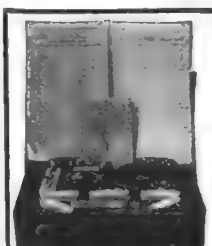

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Addresses of Patentees

(501) W. J. Cepil, Detroit, Mich., asks: "Can you give me the address of the inventors on your latest patent page and also copy of the patents?"

A. We would advise that we have no addresses of any of the inventors whose inventions are described on our patent page.

Therefore, the best procedure for you to follow, would be to write to the U. S. Patent Office, Washington, D. C., and send the number of the patent requesting the address of the inventor. Copies of the patent are supplied at 10 cents each.

If t i W shington authorities are unable to furnish you w th this address, write to the attorney thru whom the patent has been granted.

Series-Parallel Battery Connector

(502) G. E. Dransfield, St. Paul, Minn., says: "I have a device which will make it easy to install ordinary dry cells in series or multiple. It is in the form of a rack. Should I get a patent and will it sell?

A. Your device is seemingly quite clever, altho we can tell very little about it, in view of the lack of detail. If the device is made to sell at $1.00, you undoubtedly would realize quite a sale upon the same. We doubt very much whether the high-priced article will bring you the returns you should expect.

Non-Spillable Ink-Well.

(503) Henry Hartel, Brooklyn, N. Y., asks our opinion on a non-spillable ink-well.

A. There are at least 100, yes, we may say without fear of contraction, several hundred ink-wells on the market today, which can be tipt without spilling ink.

Up to the present time, there has been no very great sale for such devices. We doubt very much whether even if you did secure a patent upon your scheme, you could market it on a profitable basis. However, in view of the fact that we have no further definite information regarding the style of the ink-well you desire patented, we are unable to give more detailed information.

Sound Amplifier.

(504) Reggie Hope, Canada, writes: "I have in mind a large imitation sea shell for amplifying phonographic music, instead of the usual horn. Can I secure a patent on this? I also submit a carpet fastener."

A. The idea of using a large sea-shell for the amplifying horn of a phonograph is nothing new, and you could not possibly patent such an idea, as it is already fully covered.

Making the imitation would not be as profitable as using the real shell.

Your second device regarding a snap fastener is rather ingenious and might be a very profitable patent if properly handled. The extreme difficulty will be, however, that on the edges and corners of the carpet a metallic knob will protrude thru the carpet. If, on the other hand, this is only sewed in on the under surface, the carpet will be subject to wear over the metallic projection, more so than anywhere else.

This idea, of course, is very good, but may be greatly improved upon.

Thief-Proof Auto Lock.

(505) K. Hoigaard, New York City, writes: "I can show a plan which will absolutely prevent the theft of an automobile. What is your advice?"

A. If you can further a plan to absolutely safeguard automobile theft, the writer has no doubt but that every automobile insurance company will contribute to your rapidly growing wealth.

Up to the present time there has been no thief-proof lock or device which will make an ingenious thief beware. Locks of all sorts in the steering posts, wheels, clutches and brakes have been devised and are now on the market, but each and every one has at one time or another been the subject of attack with either an ax, skeleton key, chisel, or hammer, and, often the automobile has been successfully driven away or else towed. Therefore a good thief-proof device should not permit of towing the auto away, but it must, by the underwriter's rules, permit the car to be moved a few yards at least, so that in case of fire in a public garage, etc., the firemen or policemen can shift the car if need be. If the car is locked so as to be immovable, the insurance company may refuse to pay for fire damage.

Submarine Wreck Buoy.

(506) H. H. Hollis, Seattle, Wash., attaches a buoy, located in a recess, to the top of a submarine. This has contained within it a hose so that air can be drawn into the submarine should it sink.

A. There are many simpler devices than this one for mitigating accidents likely to occur to submarine vessels.

All kinds of buoys and floats have been devised for submarine use. None of these, however, have met with the approval of the Navy Department, as many of them would necessarily entail considerable changes in submarine design and construction.

Altho the device is feasible, we do not believe that it is even patentable, as so many of these have already been patented. Neither do we believe that the naval experts will look favorably upon this invention.

Recently a similar idea was advanced in this publication, but, we think, much improved over your system.

Radio Tuning Device.

(507) Joseph Hackerd, Indianapolis, Ind., says: "Can I obtain a patent on a tuner and tickler combination for radio work?"

A. We doubt very much whether you could obtain a patent on the tuner that you have designed, particularly in view of the fact that it may infringe on many of the tuners now in use. The extra incorporation of a tickler in your construction is nothing radically new.

Ignition Lock for Autos.

(508) Othel L. Jarrett, Charleston, W. Va., enters a set of drawings of a tumbler ignition lock for automobiles and requests our advice.

A. Altho your idea of an automobile lock is very feasible, we do not hold that it will make an automobile absolutely thief-proof, for the reason that it is a very simple matter to tap the wires leading to and from the lock and short-circuit them with another strip of metal or piece of wire, in this manner cutting out the combination of the lock entirely and allowing the automobile to be started as usual.

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New Hose Coupling.

(509) G. T. Johnson, Los Angeles, Calif., submits a drawing of a hose-coupling and explains its advantages.

A. As a detachable hose coupling, your device will undoubtedly be of considerable value, but as a permanent hose coupling your system does not compare with others upon the market at the present time, which incidentally are much cheaper.

The editor has seen a hose-coupling which was merely a piece of corrugated pipe. This was inserted into both ends of the hose and a hose clamp put around the outside. The entire device sold for 15c., including the hose clamp, and we do not believe that you could possibly manufacture your device at a similar price.

If, however, you can manufacture this device and place it on the market at no greater cost than 25c., you could undoubtedly secure quite a sale for it. We do not believe that you could obtain a patent on the same, however, but in order that you make sure we would advise that you have a search made.

Compound Gasoline Engine

(510) Joseph J. Jakubowski, Webster, Mass., submits a sketch of a gasoline engine working on the principle of a cross-compound engine and requests our opinion.

A. It would be quite impossible to have a gasoline engine work on the principle of a compound steam engine, the reason being that gasoline when once exploded has not the energy which it would have if a new mixture were allowed to enter, practically speaking, owing primarily to the instantaneous explosion of the mixture.

If the mixture exploded slowly, it might be possible to pass the hot gases into a second cylinder, to act on a second piston. When the gases entered the second cylinder, the ports between it and the first cylinder would have to be closed by quick-acting valves undoubtedly.

Sanding Device for Autos

(511) Raymond E. Koehler, Frankford, Philadelphia, Pa., submits a sketch of a sand-throwing device for automobiles to prevent their skidding and requests our opinion.

A. The idea of a sand-thrower for automobiles to prevent the machine from skidding is not new, and has been advanced by a great many experimenters.

Altho it is possible that you can secure a patent on the same, we doubt its commercial value and would hesitate at advising a patent upon the idea.

Pencil Sharpener

(512) W. E. King, Monessen, Penn., says: "I have designed a pencil sharpener using a circular disk of sand-paper. Can I secure a patent on same?"

A. The pencil sharpener which you have in mind using sand-paper instead of a cutter upon a circular disk cannot be patented, because it already is and has been upon the market for the past four or five years.

We trust that this information will not deter you from future experiments, as there are plenty of opportunities for worth-while devices to be used in office work.

Automatic Xylophone Player

(513) Howard Kreckmann, Philadelphia, Pa., asks for patent advice on a perforated paper-roll controlled xylophone.

A. There is absolutely nothing new in your idea for the operation of a xylophone or other percussion or bell instrument. Many of these are at present on the market, which operate on principles exactly identical with the one you have designed.

"Perpetual Motion" to Oust Gasoline?

(514) M. H. Karfunkle, Philadelphia, Pa., says: "The main principle of this idea is that the auto uses two storage batteries to drive a motor. This motor is connected to a dynamo to furnish power, after the motor has once been started."

A. Your idea is practically a perpetual motion machine, and would never work. The power required to propel an automobile is greater than you imagine, as you would undoubtedly know if you attempted to push the same any great distance.

You might just as well connect a motor and dynamo together, and have the motor run the dynamo and the dynamo generate current for the motor.

This idea is just as feasible as the one you have advanced, but also would not work. The storage batteries would not help the situation any. You will find, on making actual tests, that you can never get more energy out of a dynamo than that which you expend in the motor which drives it. Therefore the scheme is found to result in the eventual stopping of the motor. It may take a few minutes, but you can't get something for nothing.

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Ultra-Violet Light —Its Uses

By Prof. T. O'CONOR SLOANE, Ph.D., LL.D.

(*Continued from page* 603)

sages, would be a veritable ocean of light, and as the long waves of wireless have little regard for brick walls, our sleeping apartments in houses would be invaded at night, as they actually are at present, except that we cannot see the invader and the long waves illuminate no objects.

At the other end of the scale are waves too short to affect the retina, and these are called the ultra-violet rays. While all rays of wave-length inferior to that of the shortest part of the visible spectrum are ultra-violet, the term is not taken as applying to the very short X-ray waves and other waves in the realm of what is commonly called radio-activity. In their utilization our work has only just begun. The great movement of the day is in the direction of using what never was used before, and ultra-violet light is now being produced and used day by day in new applications.

These rapid vibrations do not affect the retina in the way of what we call sight, but they do have very notable effects on the human system. Ultra-violet rays produce a very vigorous sunburn, and in the factories where ultra-violet light lamps are made, the operators must be protected by special screening from their effects. If we go further up the scale, a lingering death may be the result from exposure to very rapid ultra-violet rays, such as X-Rays.

Ultra-violet rays are produced by the mercury vapor arc. If this is produced in a glass tube, the glass screens them off. But if, for the glass tube, there is substituted a tube of quartz, the ultra-violet rays pass thru it. In the quartz-tube mercury vapor lamp, very powerful light is produced, along with the ultra-violet rays; in other words, the invisible ultra-violet emanations are accompanied by slower waves of high luminosity.

Most curious instances of the effect of ultra-violet light are afforded by its action, when it impinges on, or is reflected from paints. White paint reflecting ultra-violet rays, may, according to its composition, display all the colors of the rainbow or be luminous. This curious effect opens up the possibility of identifying pigments without having to analyze them. It really appears at a phase of spectrum analysis.

The destructive effects of ultra-violet light are manifested in its producing sunburn on the human epidermis, but it does other harm. It is considered that the destruction of paint on a building, as time elapses, is in great measure due to the ultra-violet light present in the rays of the sun. The atmosphere, it is true, cuts off a great proportion of these rays, but enough come thru to do harm. India rubber, it has long been known, deteriorates in light, and this is attributed to the ultra-violet rays of the sunlight. Our automobile tires probably suffer from it.

But the ultra-violet rays, artificially produced, are being applied usefully also. Oils are now being treated by exposure to ultra-violet light, for the purpose of getting rid of the so-called bloom; and oils thus treated are especially fitted for use on fabric looms and machinery treating textile goods. A stain from de-bloomed machinery oil will wash out readily from a fabric and leave no stain.

Bacteria are being killed in water and in milk by them, so that there is a beneficent as well as a destructive side to them. They are used in microscopy. As the retina of the eye is insensitive to them, as

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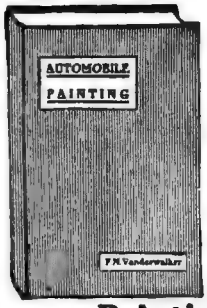

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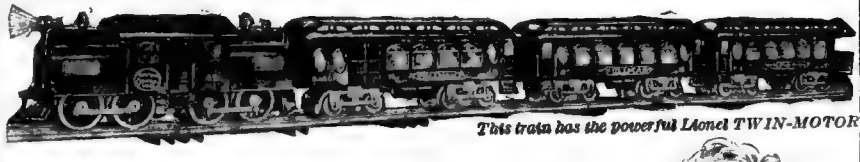

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far as vision is concerned, the photographic film is made to take its place, and photographs of microscopic objects are obtained of great perfection by these rays.

A curious example of their action on the human system is incident to the proposed ascent of Mt. Everest in the Himalayas. In climbing this mountain much suffering will be endured from sunburn, because there is so little air between the sun and the climbers, that they will be affected by the undue quantity of ultra-violet light.

There is no doubt that in a few years from the present day, numerous applications of the powers of this form of ether wave will be utilized by man. He can protect himself from it by glass, transparent or colored, so there is nothing to stop him from working with it. We are just on the verge of utilizing its many powers. There is much to be done with it, and we are only now beginning to utilize its action in the chemical and manufacturing fields. With it photographs can be taken in the dark, intelligence can be communicated by ultra-violet flashes which are quite invisible, and are detected by the photographic plate, or by causing them to produce ether waves within the range of visual activity. They may yet produce the most occult effects in chemistry.

We know that they do harm. The invention of a paint which would not be acted upon by them and which would protect objects coated with it from their effects, would be a most useful one. So in the future we may look for an extended application of ultra-violet rays in the manufacturing field, and in the development of protective methods to guard from the injurious effects, which they produce, as they emanate from our great luminary, the sun.

Bunting for flags, wall papers and other wall coverings, shipping labels, and posters and house paints are tested by a few hours' exposure, to see if they are permanent and will not fade. Airplane fabrics are sprinkled with water and exposed to the rays to try out their durability. Dyes, inks and India rubber are subjected to them to see if they will last. Feathers and animal oils are deodorized and bleached, and wax and varnishes are bleached by them.

For all such purposes the ultra-violet ray is about ten times as rapid in action as sunlight. The above is a résumé of only a few of their uses.

It will be understood that the ultra-violet rays are without effect upon the organs of sight; nothing can be seen by their aid, but their rate of vibration can be reduced or lowered by reflection from fluorescing substances, such as natural zinc silicate; the mineral becomes visible when the rays fall upon it. In the case of paint, it is believed, that fluorescence, under their effects, indicates an unstable pigment, so that they afford a test of quality of paints. Within certain ranges of frequency ultra-violet rays have little effect on animals, but affect vegetation and plant growth very favorably, and experiments in this direction are in progress.

The very destructive rays of radium salts are being applied to destroying the tissue of cancer. The ultra-violet light far less violent, yet destructive of low forms of parasitic life, is considered of value in the treatment of skin diseases. Many of these diseases are linked up with the lower forms of animal life, and if these living beings can be destroyed by the ultra-violet rays, it would seem that healing must rapidly ensue.

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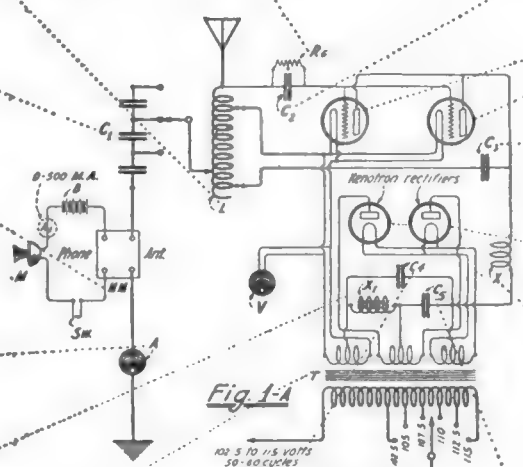

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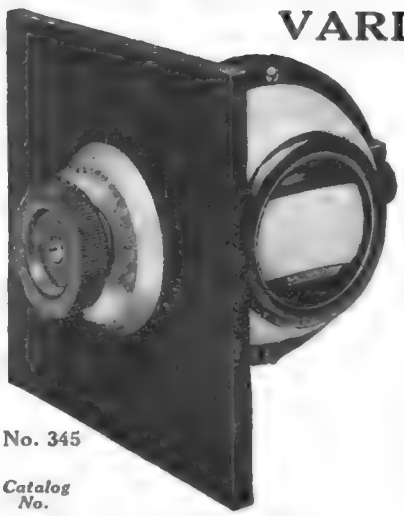

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Is the Vacuum Airship Practical?

By H. WINFIELD SECOR

(*Continued from page 602*)

Several other suggestions are shown in the illustration, including cross-bracing at the end of each compartment, which is absent from the present design of dirigible, and it would also seem advisable to run several longitudinal girders, or if nothing else just plain steel wires or cables thru the center of the frame, from end to end. to give it greater strength. If this improved form of bracing and strengthening had been employed in the ZR-2, we do not believe that the accident which destroyed it and killed most of the crew would ever have happened. The present type of dirigible, or at least those built by the British, seem to be structurally weak, owing to the fact that the vast hollow shell-like frame is relied upon to stand all the stresses and strains encountered. Such a hollow frame, like an eggshell held endwise between the palms, is very strong when a pressure is applied in a certain way; but when you have a long cigar-shaped frame and apply a stress at the center such as would be caused in rapid maneuvering, the tendency would be, no matter how rigid the shell, to break. Try this experiment with an ordinary cigar and you will be surprised how easily it can be broken when a bending strain is applied to it, and how rigid and strong it is when pressure is applied from both ends or approximately so. The same philosophy applies to the egg shell; even the strongest man rarely ever breaks an egg when held endwise between the palms and prest.

It seems hard to believe from what we have said already that we will ever see a vacuum airship fly across the ocean, but it would be a fine thing if it did, for there would be no hydrogen gas to ignite or explode and the expensive helium gas would not be needed, and therefore, such an airship would be what we might well call the ideal lighter-than-air craft. Below are a few points of interest regarding the vacuum dirigible which cable dispatches credit to Signores Vaugeau and Gargiulo.

There are three features of the construction. The first is a double envelope, one part within another. In the outside envelope an atmosphere of seven-tenths the normal pressure is maintained, whereas in the center envelope the air is much more rarefied. The layer of seven-tenths atmospheric pressure weakens the outside pressure upon the interior of the balloon, which exercises the levitation force.

The second feature is a series of hollow beams forming the frame of the machine, thru which comprest air circulates in a manner to exert a counteracting pressure against the outside atmosphere.

The third feature makes use of air heated by the motors to obtain a further decrease of the outside pressure. Professor Garuffa, an Italian expert, holds that the new machine means a revolution in flying. It will do away with the expense of the use of hydrogen and, it is said, will greatly reduce the crews needed. The inventors say that the machine when perfected with 750 horsepower motors will develop an unprecedented speed.

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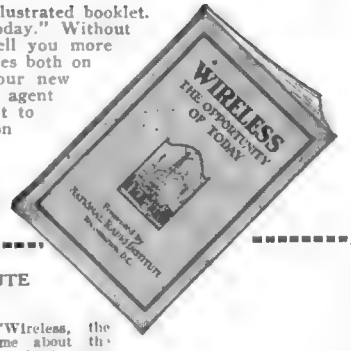

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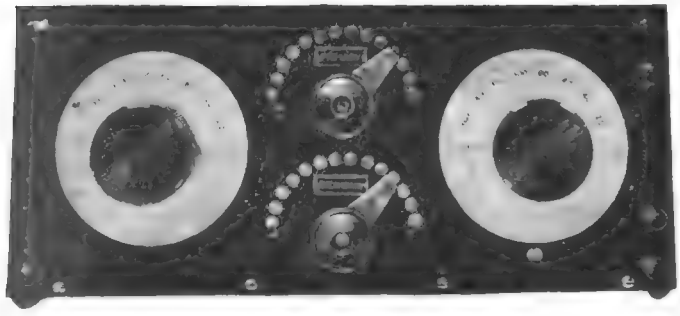
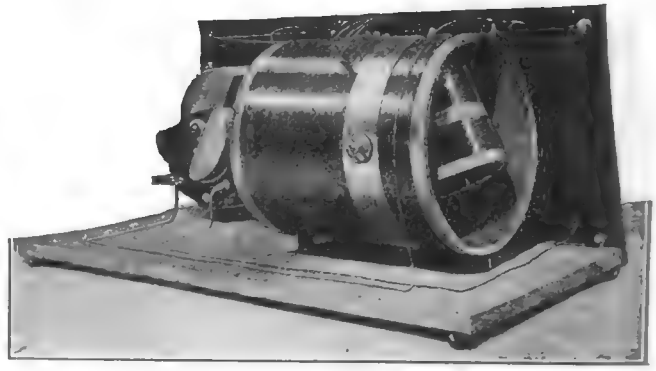
SOMETHING NEW IN RADIO

MAKE YOUR OWN





You can build this regenerative receiver easily without a machine shop. With the set of patterns especially designed it becomes a simple and easy work to make and assemble the parts comprising this set with which spark, C. W. signals and Radiotelephony may be received.

WE hereby offer the first of our series of "Make Your Own" apparatus set, the first one being a

Complete short wave regenerative set.

One of the foremost Radio engineers has constructed this set for us, specially for the amateur, and by our modern, novel methods of construction, anyone is able to make an efficient apparatus for the reception of wave-lengths up to 800 meters.

The circuit used is of the single inductance type and is the same as that used in new and well-known expensive sets recently placed on the market. With this circuit, a good selectivity is obtained, owing to the fact that the resistance of the winding in this set is rather low and so does not practically affect the resistance of the aerial, which consequently operates as a wave collector with maximum efficiency.

Another benefit resulting from the use of this circuit is the simplicity in tuning, a factor not to be neglected by the amateur not having had a long experience with regenerative circuits, in the reception of damped, undamped and radio telephone signals.

In building a Radio apparatus the lack of mechanical knowledge often handicaps the amateur in such a way that the instrument he builds has not the standard made appearance which is desirable in any Radio apparatus. In order to remedy this, and give the amateur a chance to turn out an efficient and handsome looking instrument, we have designed a special set of patterns enabling anyone to make a standard receiver with all the improvements that can be found in expensive ready-made apparatus.

With this set of patterns and by following the instructions given it is very easy with the use of only a few tools to turn out the short wave regenerative receiver shown in our two photographs.

The novel departure in this set of patterns is that we do not merely give you pictures of how the apparatus looks, and mere diagrams—BUT EACH AND EVERY PATTERN SUPPLIED IS FULL SIZE.

Take for instance the pattern for the panel. It is printed on heavy blue-print paper exactly the size of the panel to be used. The position of the holes and other markations are exact, so that all you have to do is to paste the pattern on top of your bakelite panel by means of ordinary library paste, and when dry drill right through the pattern wherever the marks are located.

This does away with all fussing and calculating as we have done all the laying out in our own shop, and you need not worry that the final instrument does not come out right.

Similar methods are used for winding the tubes, where a complete pattern is furnished so you cannot go wrong. For instance, the pattern is wound upon the tube; then you can wind the wire right on top of this, if you wish. *We have done the thinking for you.*

BEFORE SELLING YOU THIS PATTERN WE HAVE GONE TO THE TROUBLE OF ACTUALLY BUILDING THE OUTFIT AND WE KNOW THAT IT IS ABSOLUTELY RIGHT IN ALL PARTICULARS.

The original may be inspected at any time. Only standard parts are used in making the outfit. It is possible to build the entire set as illustrated for about $12 to $15.

Complete and very explicit directions go with the pattern which is furnished in a heavy envelope 9 x 12".

Complete pattern for short wave regenerative set each prepaid

50c.

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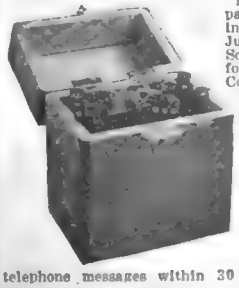

that you saw in the "movies," the daily papers, etc. Simple to install and operate. Just the thing for Boy Scouts, Campers and for use on bicycles, etc. Complete in every respect and guaranteed to give complete satisfaction.

Just connect your aerial ground and phones and you are ready to receive messages. Tunes to 800 meters and receives telegraph messages within 1,000 miles radius and wireless telephone messages within 30 mile radius.

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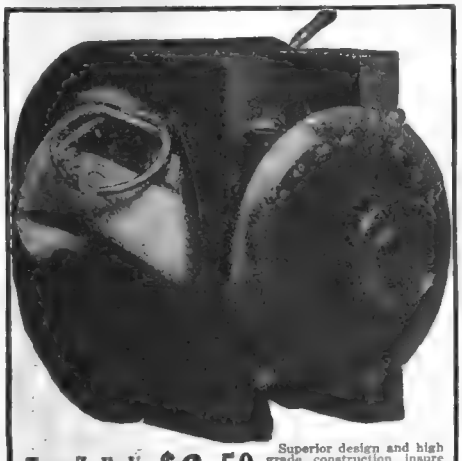

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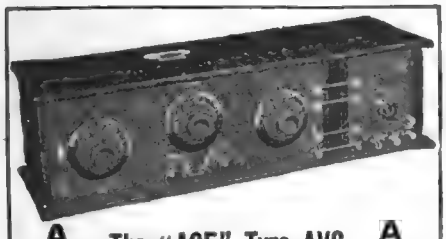

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Complete as illustrated..... $56.00

This unit is admirably adapted for relay work over long ranges and combines the essential features of maximum signal amplification without distortion, maximum selectivity and the necessary flexibility which permits of rapid tuning of the various circuits. Unquestionably the ideal receiver for the Radio Amateur.

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70 Van Wyck Blvd., Richmond Hill, N. Y.

A Yacht Radiophone

By C. GOLDEN

(*Continued from page 631*)

peres when using CW, in this connection it might be well to state that the ship's antenna had a fundamental wavelength of 295 meters, a capacity of .00058 M.F. and a high frequency resistance of 12 ohms at 300 meters, so the antenna in-put was from 48 to 108 watts, the latter figure when overloading the oscillator tube alone to a high percentage over its normal rating, increased filament current, etc.

The panel lay-out is very similar to the Navy type radiophone used on their flying boats, but the circuit is decidedly different and the best available for this purpose.

The circuit used is shown in Figure 2 and employs the Heising Constant Current system of Modulation. The oscillator tube is to the right and the modulator to the left, both being supplied from a constant source of current from the high potential generator G-1 thru the iron core choke L-5. The variations of current G-1 and L-5, at the signal frequency, is of course opposed by L-5, so that when variations of grid current in the modulator tube are caused by speaking into MH, the space current taken by the modulator tube varies accordingly and this variation also has to take place in the oscillator tube, inasmuch as the choke L-5 offers high impedance to generator current variations, and the variations are imprest upon the oscillator simultaneously. The oscillator then supplies variations to the antenna system in strict accordance with the original variations caused by speaking into the microphone MH, or by the buzzer when using modulated CW telegraph signals.

The modulator system is independent of the high frequency circuit, and when using straight CW, the modulator filament circuit is broken, and this does not affect the oscillator system in any way. The only adjustment of the modulator circuit that is necessary for the operator to make is the negative potential, which has to be varied to operate the tube on the proper point of the characteristic curve. The proper point can easily be determined locally with a tone tester. L-4, the high frequency air choke, is provided to prevent the radio frequency from returning to the modulator circuit. C-3 and C-4 are stopping condensers, C-3 being .0005 mf and C-4 .001 mf. L-2 is the main inductance, the value of which in connection with value of C-1 and antenna constants determines the transmitted wavelength. In the actual circuit two different wave lengths are available thru the control switch. L-1 is the plate feed back inductance with its fine adjustment condenser C-2, which is finally fixt permanently. L-3 is the grid feed-back inductance. R-1 is the grid leak and the CW signaling key is right in that lead.

B-1 is the negative potential, being variable between 20 and 60 volts in steps, the fine adjustment being given with a potentiometer. B-2 is 6 volts of dry cells for the microphone and buzzer. The value of R-1 is 5,000 ohms and of R-3 48,000 ohms. The modulation transformer T is of special design, the proper ratio being worked out for the particular tubes used. The filament rheostats have a value of 4 ohms, their frame is made of Lavite and the wire is Nichrome.

Three meters are provided, one for the antenna current, one for the total space current of the tubes and the other to read total filament current.

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The source of high potential is interesting. A dynamotor is used, the motor half taking 24 volts and the generator half giving 1,500 volts, the supply voltage coming from the ship's generator, which was a 32-volt lighting system, thru a special resistance. This dynamotor has auxiliary handles and gears and can be driven manually by two men with somewhat reduced output, but under actual tests we were advised that CW range under these conditions was obtained for 350 miles. The machine is shown in Fig. 3.

A regenerative receiver was first supplied with this transmitter, but later supplanted by an Armstrong Super-Autodyne Receiver having a wave-length range of 160 to 850 meters, using a loop antenna. This receiver had only two controls, the oscillator condenser and wave-length adjustment and simplified operations considerably and allowed duplex operation with another station, if the wave-lengths of the transmitting and receiving stations were reasonably separated.

The station is purely experimental and even tho it is located in the tropics a greater part of the time, we were advised that CW signals have been heard approximately 500 miles, with a phone range 50 miles at almost any time static is clear; the antenna height is only 30 feet, and the apparatus in the hands of relatively unexperienced men, technically considered.

Hints on Staining Wood

(*Continued from page 629*)

toned down with raw sienna. Open the cans and take out a small teaspoonful of each and place in a clean vegetable can, cup or whatever else you may have handy. Beat this up in the cup with a little linseed oil, say enough to cover the pigments, with a small flat stick or putty knife. Bear in mind that any stain is not to be used thick like paint, but must be used very thin to let the natural grain of the wood show through. Stain is merely used to impart color to the wood. Indeed, if you wish you may take rags, waste, etc., and wipe all the stain off the surface of the wood. Destroy all oily rags after using. Any paint or stain on a rag may lead to fire by spontaneous combustion. Now, as you have the pigment in the cup "beat up," you can thin it down by adding ½ linseed oil, ½ turpentine. (The turpentine makes it penetrate). Also add some Japan dryer, say ¼ tea cup to a pint of stain. Now try the stain on a small piece of the same kind of wood as your cabinet, and see the effect. By varying the proportions of the pigments you can make the stain to suit yourself. The following are the combinations to produce the different stains: Oak, raw sienna, burnt umber; Cherry, burnt sienna, raw sienna; Walnut, burnt umber, burnt sienna; Mahogany, vandyke brown, rose pink.

These are known as "oil stains." You can buy the above pigments in dry form if you wish and "beat them up" in alcohol, adding a little orange or white shellac to bind the stain, that is, to keep it from rubbing up when varnishing over it. You may purchase liquid filler and beat up your pigments (in oil or dry) in turpentine and add them to the filler, thus filling and staining in one operation.

Contributed by F. H. SWEET.

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	Now	5.75
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Detector Panels
(as illustrated)
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One Step Amplifier Panels same type as illustration with amplifying transformer and telephone jack attached $12.50

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Opportunities as a Radio Man.

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Variometer Wood Parts (Unassembled and Unwound)	2.00
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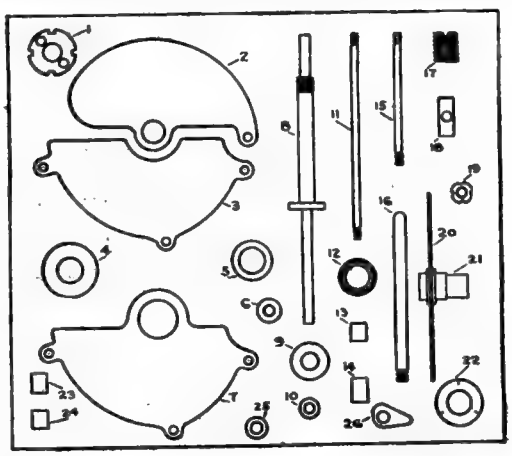

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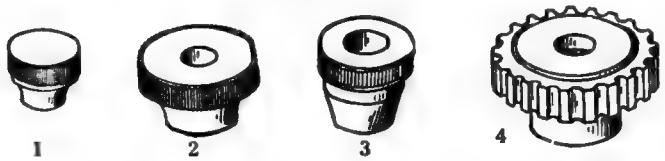

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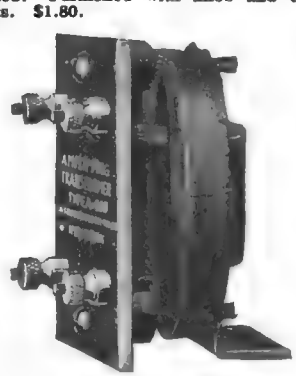

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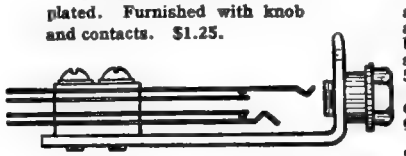

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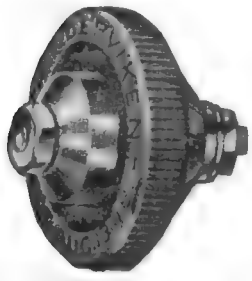

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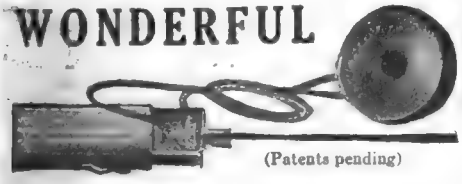

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Electric Heat Makes Gas Cheaply

By EDWIN IRVINE HAINES, B.S.

(*Continued from page* 611)

heaters for the checkerbricks in the carburetor and superheater, and eliminating the generator entirely from the process of gas manufacture, Mr. Burhans Van Steenbergh, a well-known gas engineer and president of the American Gas Improvement Company, has perfected a process that scientists say may revolutionize the gas business, inasmuch as it produces a continuous, uniform electric heat of the exact degree required, giving a constant flow of gas having a uniform high candlepower and converting all of the hydrocarbon oil into fixt gas with practically no waste.

Under the Van Steenbergh Process, as the new method is called—the first to utilize electricity in the manufacture of illuminating and heating gas—the mixing and fixing of the hydrocarbon gas of the oil with the hydrogen and carbon monoxide gas (water gas) takes place in the carburetor, or fixing chamber, which is kept at a uniform temperature of 1,200 degrees Fahrenheit by the electric incandescent heaters here shown.

The converting of the water into steam is accomplished in an ordinary boiler, heated to 300 degrees Fahrenheit by coal or fuel oil. The steam is then passed thru a coil of pipe located in the upper part of the carburetor, or fixing chamber, called a pre-heater, which has previously been raised to a heat of 1,200 degrees Fahrenheit by the electric heaters, and which takes only from 5 to 10 minutes' operation.

The subsequent passing of the steam thru the superheater raises it to a temperature of 1,800 degrees Fahrenheit and it is converted into hydrogen gas and the oxygen gas is eliminated by the introduction of oil during the super-heating process, giving carbon monoxide gas.

The oil also gives rich hydrocarbon gases, thru the utilization of the heat of the manufactured gas in the pre-heater, which raises the oil to a temperature of 800 degrees Fahrenheit.

It is to be noted that all steps in the Van Steenbergh Process are conducted simultaneously, while the gasifying of the gas oil and the production of the water gas from the water, takes place outside of the carburetor, effecting an improvement in this connection over other processes of gas manufacture use.

The carbonic oxide and hydrogen gases are introduced into the carburetor at 1,800 degrees Fahrenheit and the hydrocarbon gas at 800 degrees Fahrenheit. The gases are then mixed and fixt in the carburetor where they form the fixt gas, the final product being then scrubbed, washed and purified as in the Lowe process, is past into the holder ready for use.

No new, or untried apparatus or method, is employed in the Van Steenbergh Process. The novel and valuable feature is the new combination of old apparatus and methods, which, by the use of electric heat in the carburetor, maintains a uniform, predetermined temperature at all times, and, therefore, makes the production of gas a continuous one instead of an intermittent and unsatisfying one.

In practise the Van Steenbergh Process produces with the apparatus illustrated about 60,000 cubic feet of gas per hour at an estimated cost of 40 cents per thousand cubic feet or about $23.96. The saving effected over the old process is therefore from 25% to 50%.

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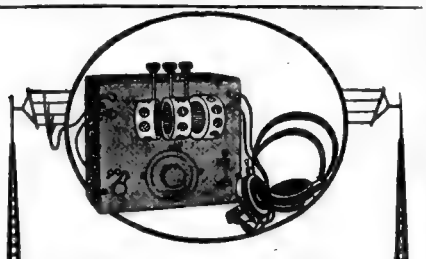

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Arc Welding of Audion Parts

By F. A. ANDERSON

(*Continued from page 632*)

quency incoming signals into low frequency pulses, which are audible as a musical note in the telephone receiver.

Within this tube is a tungsten filament surrounded by a nickel helix and a nickel cylinder. The helix is composed of several turns of spring nickel wire .02 inch in diameter, which is electrically welded to a nickel wire support .03 inch in diameter. So successfully is this weld made that only one support is necessary to hold this helix in place within the cylinder. The cylinder is ¾ inch in diameter, ½ inch long and is made of sheet nickel .007 inch thick. It is supported by a nickel wire .03 inch in diameter, the wire being electrically welded to the cylinder.

The other receiving tube is known as the amplifier. Its purpose is to strengthen very weak signals in order that they may become audible. Both the detector and amplifying tubes are very similar in appearance and construction, and it necessarily follows that the welding operations are also similar in character. In the amplifier the sizes to be welded are of much smaller sectional area than those of the detector. The grid or helix of the amplifier is made of wire about .01 inch in diameter, while the cylinder is only about ½ inch long, ⅜ inch in diameter and made of sheet nickel .003 inch thick.

The transmitting tube is a somewhat later development and is used more particularly in Radio-telephony. It is a valuable aid in producing the continuous high frequency current necessary for transmitting speech and music.

Within this tube is a molybdenum helix and cylinder. The helix is ⅛ of an inch in diameter, made of wire .0056 inch in diameter, electrically welded to a nickel wire .015 inch in diameter which nickel wire is in turn welded to a copper conductor. The cylinder is ⅜ inch in diameter, ⅝ inch long, made of metal .003 inch thick electrically welded to a nickel angle 3/64 inch x 3/64 inch x .005 inch thick.

The tubes mentioned in the foregoing description are partially shown in the accompanying cuts.

The DeForest people manufacture a similar but a much larger and more powerful type of tubes, and in which electric welding is used for the joining together of a number of different kinds of metals.

Within these tubes tungsten is welded to dumet; nickel to tungsten; copper to nickel; molybdenum to nickel; iron to molybdenum; molybdenum to tungsten; and copper to dumet. All of these metals are of very small sectional area, being under 1/16 of an inch in diameter or thickness.

The electric welding is all of the resistant type and is of the kind generally known as *spot welding*. The delicacy of the work may be judged from the fact that in one instance the two electrodes and the wires to be welded are within an area 3/16 of an inch in diameter and this inside of a glass tube.

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THE CREATORS OF PEARLS

The Filled Tooth

By CHARLES S. WOLFE

(*Continued from Page* 608)

sure. Finally, satisfied, Hazard returned to his bench and his work.

A few more cuts, mere scrapings, a final set of micrometer tests, and he loosened the vise. Removing the little object from the jaws, he held it carefully in his left hand. Taking up a pair of small tweezers with his free hand, he drew toward him a small, cardboard box. From this the tweezers deftly lifted several small, exquisitely fashioned parts, which were painstakingly inserted into the cylinder-like interior of the piece on which he had been working. With infinite care he adjusted the fitted pieces to his satisfaction. Finished, he laid the assembled work on the bench.

For awhile, hands on hips, he gazed down on his handiwork. Then, pulling open a small drawer, he brought forth a dab of cotton, removed from it a glittering object, and placed it on the table beside the first. He drew a breath—almost a sob—of relief and gratification. They were as alike as twins.

And the thing he had taken from its cotton swathing was—a dog's tooth!

Hazard made micrometer comparisons of the two. With each reading he grew more jubilant. He could not have done better. What slight differences existed were to be exprest in thousandths of an inch. To all intents and purposes the tooth that Hazard had created and the one drawn from Ted's upper jaw were identical—externally.

Taking up his masterpiece he once more examined it critically. He worked the smoothly sliding piston up and down in its tiny cylinder. At each downward thrust, the needle of this weird hypodermic syringe protruded wickedly from its microscopic socket. He tested the automatic action—an idea that he had worked out himself—which caused the needle to leap forth on the application of a modest pressure at the base. He smiled grimly. Ted's closing jaws would supply ample pressure.

On the outer surface of the tooth, almost unnoticeable, he had fashioned a safety catch. This he now prest, locking the needle. Test showed that it withstood considerable force. He was assured that the serpent's fang would not strike until he willed it. So far everything was working out nicely.

He laid the tooth gently on the bench, and strode to a medicine cabinet on the opposite wall. Involuntarily he shuddered as he brought forth a small glass jar. Yet his hand was steady enough as he placed the jar on the bench and pulled toward him a blank microscope slide.

With the deftness of long practise he made a smear on the slide with a bit of the contents of the jar. Rapidly he prepared the slide for the instrument, and, completed, placed it on the stage.

He selected an eyepiece of an appropriate power, focused with a practised hand, altered the illumination slightly, and bent to a close and careful scrutiny of the smear.

He watched the wriggling things which swam before his vision with mingled pleasure and loathing. He had reared this culture himself, bred it painstakingly, as he had done everything else connected with his enterprise. Now the whirling view in the eyepiece told him that his efforts had borne fruit. The colony was splendidly active, wonderfully virulent.

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Leaving the microscope, he took up a small pipette and approached the jar. As an afterthought, he paused to draw on a pair of rubber gloves. Then carefully he filled the pipette from the contents of the jar, and as carefully charged the tooth's cylinder from the pipette. He noted that the safety catch was in proper position, dropt the pipette into an acid bath standing close at hand, and capt the base of the tooth.

The jar was replaced in the cabinet. Returning to the table, he glanced over the array on its top. Apparently he had neglected nothing. There were no carelessly spilled drops, no accidentally impregnated objects. Yet he paused again to make sure before removing his gloves. The deadly micro-organisms that he had called into being were no respecters of persons. He knew too well the consequences of accidental innoculation.

One more task remained. Moving over to a little table, he spoke abruptly to the dog. "Up, Ted! Up here."

Obediently, but with marked reluctance, the collie approached the table, sprang on it, and tremblingly crouched. Without ceremony, Hazard rolled him over on his back, fastened his legs securely with straps, and inserted a rubber wedge between his jaws. Thus parted, the rows of strong, white teeth glistened. Hazard examined them critically. One of the upper set, in front, was missing, a gaping cavity conspicuous among the even, white beauties. On this cavity he concentrated his attention, a brief, expert survey assuring him that the gum was in splendid condition.

He took up a paper cone, unheeding Ted's low whines of fright, of terror inspired by the dread of the unknown, and proceeded to administer the anesthetic.

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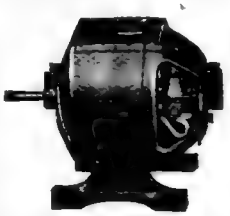

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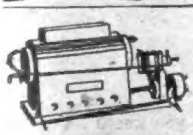

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Swiftly he worked over the unconscious dog, and when he straightened up, satisfied, the gaping cavity was gone. The row of teeth was unbroken.

He had inserted the tooth which he had fashioned. It was firmly fixt to the jaw bone. It rested securely with its freight of *hydrophobia virus*. It needed only the release of the safety catch to transform Ted into a mad dog.

With as much care as he would have bestowed had his patient been human, Hazard nursed the dog out of the ether, strove patiently to allay the nausea, patted away the terror.

He was rewarded at last by a state of comparative calm on the dog's part, and, making the collie as comfortable as he could for the evening, he locked the door of the shop and made his way to his room.

Dropping wearily into a chair, he gazed with unseeing eyes out into the night. To-morrow would be his day—the day he had waited two years to see. To-morrow he would redeem his promise, make good his word.

One swift snap of Ted's jaws, and Sylvia's husband—how he hated the word—would be as good as dead. And he would suspect nothing. He did not know Hazard. They had never met. Hazard had disappeared quietly from his home town after this stranger had taken Sylvia away, and taken up his quarters here on the man's very doorstep. Cautiously he had watched and noted. He had the time of the man's goings and comings carefully catalogued. He knew just where to find him on the morrow.

There would be a little row after the bite, of course. He had the details of that scene all carefully planned. The course he would pursue would smooth the thing down quickly, and all would be over. He would come home, and in a couple of days, for the neighbors' benefit, he would publicly shoot poor Ted. He would let it be known that he suspected that the dog was going mad. Possible investigators would get these details if by any chance investigation was instigated later. There seemed no chance of a fluke.

He felt a pang of pity, almost remorse, as he thought of the other's horrible fate. Hazard was not by nature cruel. He had always been tender-hearted to a fault. He would have preferred something quick, painless. But what was he to do? There was the law, ready to act, ready to defeat his end. The man's death was not his end, it was merely a necessary means to that end. And plot as he would, he could not evolve a more merciful means without incurring unthinkable risks to himself. No, it had to be this—or nothing.

Thru the long hours of the night he lay on his bed, sleepless. Thoughts, long processions of them, grim, bitter, searing, kept him horrible company thruout the vigil. But they failed to shake his resolution, failed to unsteady his nerves. A cold plunge brought him refreshed to his day of trial.

Promptly at the time appointed, Ted on a rather long leash at his side, he sauntered deliberately up the avenue. He glanced at the watch on his wrist. His man should be dismounting from the next car.

He scrutinized the descending passengers. Yes, there he was! Hazard prest forward.

Sylvia's husband, as was his wont, started up the street at a good gait. On his heels, Hazard and Ted fell into stride. Slowly, unnoticed, they drew abreast of the man.

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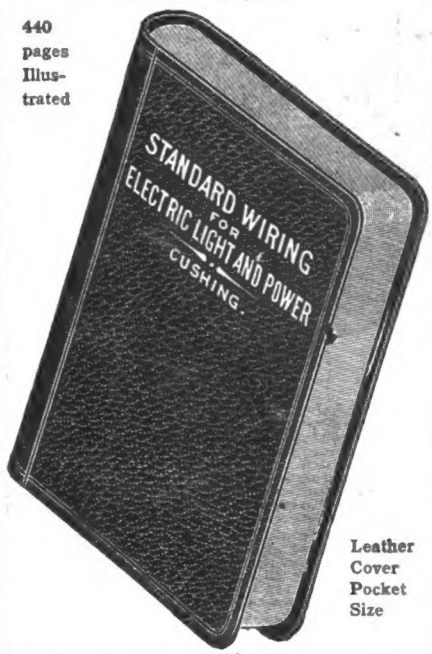

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Ted felt suddenly the pressure on his flank. Swiftly he whirled. There was a scream of pain as his keen teeth sank into the calf of the victim's leg. At the scream pedestrians turned inquiringly.

Simultaneously, Hazard acted, acted as he had planned to act. With a splendidly simulated oath of surprise and wrath, he brought his dog whip down across Ted's back with stinging violence.

The astonished dog felt the biting lash on his back. He had expected a caress. Confused, he evidently took the blow for an attack from a strange source, and whirling like lightning, he sank his teeth into the nearest object—his master's descending hand!

Hazard felt those teeth pierce his flesh, and his blood went cold. Yet, somehow, his iron nerve did not fail him. He realized that he must keep cool, show no undue alarm, lest he betray himself. Sylvia's husband, his face distorted with pain and rage, was demanding an explanation of the attack. A crowd was surging around them. He forced himself to speak coolly, glad that the slight tremor of his voice would appear only natural under the circumstances.

"Sorry, friend," he heard himself saying, just as he had planned to say, "Mighty sorry. The dog never did anything of the kind before. I can't see what caused him to do it. My fault, of course. Here's my card. Have that wound treated by a physician and send your bill to me. If you like, I'll shoot the animal."

Mollified somewhat, Sylvia's husband responded with the best grace he could. "Not necessary to shoot the pup," he mumbled. "Ought to muzzle the vicious beast. I'll see a doctor."

Raging inwardly at every second's delay, for every second was precious now, Hazard managed at last to get away from the curious throng. He did not dare to run, as he wished to. He forced himself to be content with a brisk walk until he rounded a corner and was lost to sight by the eyewitnesses of the recent scene. Then he began to run for it.

Once in his shop he worked feverishly, frantically. Ted, unable to understand, sulked terrified in a corner. Hazard spared himself no pain as he fought to draw the impregnated blood from his lacerated hand. For a half an hour he worked, squeezing, cauterizing, applying antiseptic washes.

Finally he bandaged the wound and sank into a chair. He could do no more. His head dropt wearily into his hands. He knew his fate now. Sylvia's husband was totally unaware of the horror hanging over him, but Hazard, with the knowledge he possest, faced weeks of uncertainty, anxiety, torture. It was just barely possible that he had saved himself, but he could never be sure. The chanees were all against him. The very care he had taken to insure a deep injection of the destroying virus was against him. He was a lost soul.

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"Sylvia! Little lost sweetheart! Lost forever now."

The minutes, the hours, ticked by, unheeded. Hazard sat and faced his future. Finally he straightened up with a jerk. Slowly he pulled out a table drawer and drew forth a heavy revolver. There was a spit of red flame, a deafening roar in the closed room, the reek of burned powder in the air, and Ted, faithful comrade, hapless tool, relaxed in his corner. Hazard had spared him a worse fate.

He laughed, aloud. Whimsically the thought came to him. He had been so sure that he could not be caught, that nothing would betray him, that he would never face a court. He had forgotten one witness—one judge!

Slowly he raised the revolver. His face was set in hard grim lines. He was drinking deep of a bitter, bitter cup. The laborer was worthy of his hire—and he was about to receive it. The wages of sin—the fate of a mad dog!

Magnets and Cranes to Handle 'Planes

(*Continued from page* 605)

for starting, the electric motor controlling the rotation of the jib is started and the arm revolves; a second electric motor being switched into circuit, which causes the outer end of the jib arm to rise slowly. Thus as the arm increases in speed, it is slowly raised and the pilot in the meantime has started his engine and propeller. When the jib has reached an approximately horizontal position, the pilot of the airplane throws on more power and it glides off at a tangent to the circular orbit described by the outer end of the revolving jib. As the illustration shows, the airplane rises in an upwardly inclined evolute spiral.

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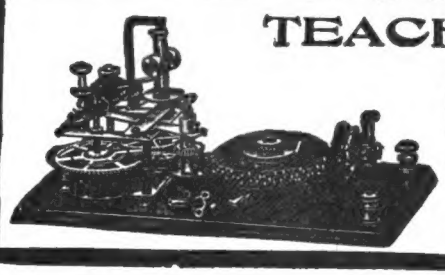

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Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

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